"Journal of Gas Lighting, Water Supply, and Sanitary Improvement."—April 25, 1916.—Registered as a Newspaper.

Journal of Gas Lighting and Water Supply

UNIV. OF MICH. LIBRARY

Vol. CXXXIV. No. 2763.] LONDON, APRIL 25, 1916. [68th Year. Price 6d.

O'NEILL'S
OXIDE
GAS PURIFICATION & CHEMICAL CO., Ltd.
PALMERSTON HOUSE, LONDON, E.C.
Telegrams: "PURIFICATION, LONDON."
Telephone: 9144 London Wall.

TORBAY
STOVE BLACK
FOR GAS COOKERS.
The TORBAY PAINT CO.,
26, 27, & 28, Billiter St., London, E.C.
39-41, Old Hall St., Liverpool.

PUMPING ENGINES
All Types for ACID, &c.
CAST-IRON OR STEEL TANKS
Any Capacity.
CHEMICAL PLANT.
Roofs and Girders. Structural Work.
SULPHATE OF AMMONIA PLANT
Air and Gas Compressors.
MIXERS.
TAR STILLS AND CONDENSERS.
W. NEILL & SON, Ld.
Engineers, Iron & Brass Founders,
ST. HELENS JUNCTION.
Telegrams: 'Neill, St. Helens.' Telephone No. 20.

BROWNOX-DE-LUXE
and
BROWNOX
British Purifying Material
Of Proved Efficiency.
SPENT OXIDE PURCHASED
Exchange or Loan Terms Arranged.
J. BROWN & CO., Ltd.
Savile Town, DEWSBURY.

THE UNITED...
FLEXIBLE METALLIC TUBING CO., LTD.
FOR GAS, OILS & HIGHEST STEAM PRESSURES
112, QUEEN VICTORIA St E.C.
Works: PONDERS END, MIDDLESEX.

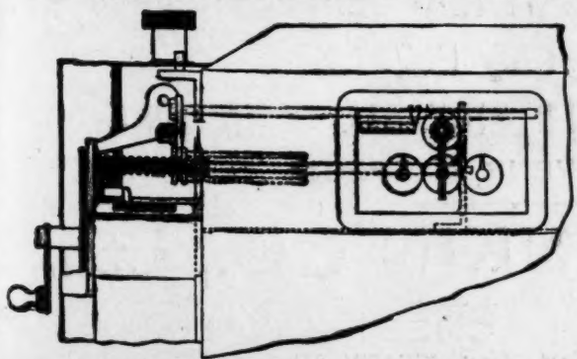
Makers of
GASHOLDERS,
TANKS (C.I. or Steel),
PURIFIERS,
WASHERS,
ROOFS,
&c.
ASHMORE, BENSON, PEASE & CO., LTD.
STOCKTON-ON-TEES.
Complete GAS WORKS
London Office:
39, Victoria Street, Westminster, S.W.
Telegrams: "GASHOLDER."

JAMES McKELVIE & CO.
Coal Owners,
Cannel and Gas Coal Contractors,
17, RUTLAND SQUARE, EDINBURGH.
59, MARK LANE, LONDON, E.C.
Telegrams: "Mackelvie, Fen. London."
Telephone: Avenue 2177.
GUILDHALL CHAMBERS, SANDHILL, NEWCASTLE-ON-TYNE.
24, CHAPEL STREET, LIVERPOOL.
VICTORIA BUILDINGS, BUTE DOCKS, CARDIFF.
Prices and Analyses of all the Principal Cannel, Gas, and Steam Coals forwarded on application.
ESTABLISHED 1840.

W. & B. COWAN
Incorporated in Parkinson and W. & B. Cowan, Ltd.
LONDON. MANCHESTER. EDINBURGH. GLASGOW.
SYDNEY. MELBOURNE. BRISBANE. WELLINGTON, N.Z.
(See Advertisement on page. III. of Wrapper.)

STEWARTS AND LLOYDS, LIMITED, 41, OSWALD STREET, GLASGOW. BROAD STREET CHAMBERS, BIRMINGHAM.
TUBES & FITTINGS for Gas, Steam, Water, &c.

GEORGE GLOVER & CO., LTD.,
CHELSEA.



"THE STANDARD"
SLOT METER.
THE ACME OF SIMPLICITY.
NO SPRING in any part of the mechanism.
Can be fitted with STRONG BOX, if desired, or with "M & M" LOCK.

London:
RANELAGH WORKS,
ROYAL AVENUE, CHELSEA.
TELEPHONE: Kensington 1140.
WIRE: "Dry Meters, London."

Leeds:
9, DEWSBURY ROAD,
TELEPHONE: No. 2934.
WIRE: "Meters, Leeds."

Manchester:
GAYTHORN METER WORKS,
EASTON STREET.
TELEPHONE: No. 6898 City.
WIRE: "Slot, Manchester."

R. & J. DEMPSTER, LTD. 52 & 2660 Manchester.
PAN ASH, COKE BREEZE & COAL WASHER.
SOLE MAKERS OF THE PATENT NOTTINGHAM BOILER.

RITCHIE C.I. PIPES FOR GAS & WATER. MIDDLESBROUGH.

EXTRA REFINED

EXHAUSTER OIL.

DONALD MACPHERSON & CO., LTD., MANCHESTER.

ARROL-FOULIS
Stoking Machinery
HYDRAULIC COKE PUSHERS
(HUNTER and BARNETT'S PATENT.)
WILL DISCHARGE A RETORT IN ONE OPERATION,
LARGE NUMBERS IN USE.

Full Particulars may be obtained from the Sole Makers,
SIR WILLIAM ARROL & CO., Limited,
GLASGOW.
LONDON ADDRESS: 56, VICTORIA STREET, S.W.
[Illustrated Advertisement, April 18, p. 155].

SIMMANCE'S
INCORRODIBLE DEAD BEAT RECORDERS
Are BRITISH MADE and Accurate.

Comparison with other Recorders is invited.

Hundreds of ranges for any vacuum or pressure
(Foul or Pure Gas, Air, Steam, Water, or Oil).

Sole Makers: **ALEXANDER WRIGHT & CO., LTD., WESTMINSTER.**
AGENTS: Australia—FYVIE & STEWART, 360, Collins Street, Melbourne; Canada—W. P. ROPER, 502, Merchants' Bank Building, Montreal.

RATEAU TURBO GAS EXHAUSTERS
ALSO FOR
PRESSURE RAISING AND COMPRESSING.
Manufacturers under Licence from Professor Rateau.

WE HAVE SUPPLIED AND HAVE ON ORDER—

ELEVEN machines, driven by Electric Motor and Steam Turbines for use **in connection with Coke Ovens** of a capacity of 2,960,000 cubic feet per hour; and

THIRTY-FIVE for Gas and other Works, &c., capable of dealing with 16,440,000 cubic feet per hour.

Total Capacity: 19,400,000 cubic feet per hour.

MAKERS ALSO OF

VALVES OF ALL SIZES & TYPES (AIR & GAS) and for HIGH or LOW PRESSURES. **DISTRICT AND SERVICE GOVERNORS.**

HIGH PRESSURE GAS PLANTS.

GAS EXHAUSTING PLANTS TO SUIT ALL CONDITIONS.

VALVES FOR COKE OVENS A SPECIALTY.

THE BRYAN DONKIN CO., Ltd.,
Engineers and Ironfounders,
Head Office and Works: CHESTERFIELD.
London Office: MILLBANK HOUSE, Wood Street, WESTMINSTER, S.W.
Chesterfield Telephone No. 84.
London Telephone No. 5858 Victoria
Chesterfield Telegrams, "Donkin Chesterfield."
London Telegrams, "Donkin Vic. London."

JOURNAL OF GAS LIGHTING & WATER SUPPLY.

EDITOR & PUBLISHER: WALTER KING. OFFICE: 11, BOLT COURT, FLEET ST., LONDON.

VOL. CXXXIV., No. 2763.] TUESDAY, APRIL 25, 1916. [68TH YEAR.

EDITORIAL NOTES.

Coal "Shortage" and Compensations.

COLLIERY owners have been making shortage of coal output a strong point of their case for higher prices, for non-delivery under contracts, for justifying higher prices in the open market, and generally for making private bargains which evade the Price of Coal (Limitation) Act. But the actual shortage at home has not any very real existence when all things are taken into account. It was recently seen from the official figures that the total output of coal for 1915 amounted to 253,188,000 tons, as compared with 287,412,000 tons in 1913, or a reduction of 34,224,000 tons. It must, however, be remembered that the year 1913 was quite a "bumper" one in output. Last year, compared with 1914, exhibited a decrease of output amounting to 12,455,000 tons—the output in 1914, which contained seven months of peace, having been 265,643,000 tons. The reduction last year contrasted with 1914 is only equal (the "Iron and "Coal Trades Review" points out) to 4·7 per cent., though the number of men underwent a reduction of 12 2 per cent. This speaks of better and fuller working. But remembering that 1913 was a record year for output, and that last year fell short of that output by 34,224,000 tons, it is interesting to note that the coal export in 1915 was no less than 29,865,347 tons below that of 1913—the figures having been 73,400,118 tons in 1913, and 43,534,771 tons in 1915. Therefore, the difference in supply at home last year—deducting reduction of exports from diminution of output—was only 4,358,653 tons short of the big output year 1913. The amount does not virtually represent what can be called a "shortage;" and it should not be difficult to make up. The Exports Committee have been continuing their work of reducing the amount of coal for which they issue export licences. For example, in March this year, only 3,032,933 tons of coal were allowed to leave these shores, compared with 5,909,722 tons in March, 1914—showing a reduction of no less than 2,876,789 tons. In March last year, 3,977,273 tons of coal were exported, which was a reduction on March, 1914, of 1,932,449 tons. The diminution for last month was therefore no less than 944,340 tons in excess of the reduction made in 1915 over 1914—nearly 1,000,000 tons in a single month! There is hardly an instance of a country abroad (excluding France) to which last month there was not a shrinkage of exports contrasted with March last year. The 944,340 tons increase in the reduction of coal shipped abroad shows how quickly the Coal Exports Committee can effect a balance between the coal available for consumption at home in 1913 and the reduced output for home consumption during last year, which difference, however, does not necessarily represent any real "shortage." Moreover, in 1913, there were large stocks of coke at gas-works; now most gas-works could sell more coke if they had it for disposal. This is evidence that the absorption of coke has helped to counterbalance the so-called "shortage" of coal, notwithstanding that there was last month an increased quantity of coke exported. The amount was 139,457 tons, which is but a "drop" in the ocean of coke output; but it compares with 68,281 tons in March, 1915, and 82,898 tons in March, 1914.

Power in Central Organization.

AT one time it was said by those who loosely viewed the question that there was no demand on the part of those controlling the administrative policy, the finance, and the commercial work of the gas industry to become identified with any central organization. There was a modicum of truth then in the assertion; but the assertion has been dissipated by event. A mistake was made at the time in considering the question from the point of view of demand, and not of need. Moreover, there had been no opportunity for those in question to become identified with the work of the industry beyond the limits of their own immediate undertakings. What, however, happened directly the British Commercial Gas Association came into being? Did the men governing administration, finance, and commerce, in connection with 80 per cent. of the statutory gas supply of the United Kingdom refuse to concern themselves with that wise and effective piece of enterprise? The fact that they did not decline proved that, given the opportunity, they were prepared to co-operate in the work of the industry—that is to say, in work that applies to the whole industry, as distinct from the work of administering each undertaking. And they would be equally willing to take part in the larger work which is not covered by the only organization in which they are allowed membership. What happens at present? Their membership of the British Commercial Gas Association confines them to matters which have to do with gas publicity and educating the public, which is highly essential work. But why limit the brains of administration and commerce, and the power of those in financial control, to such work? The absurdity of the existing position exudes from every word composing the question. There are numerous matters of policy—legislative, financial, and commercial—arising out of the developments of the industry, in connection with which the talents of administration and the power of position would be of the utmost value to the industry as a whole. But the industry is denied the help. And why? Simply through lack of complete organization. Yet all the help that is available is to-day required in the industry's central parliament.

Look back at some of the changes that have occurred in the gas industry. Associated with them are the critical fights in Parliament for the industry's liberty, the organized attacks upon the industry in Parliament, and the gradually increasing vigour of the competitors in business—not only electricity, but coal. In dealing with all these matters that have been incidental to change and vital to the industry, there has been an overlapping of the organized interests, and one organization has been unable to move without one or more of the others. Sometimes in taking action the Gas Companies' Protection Association have had to go to the Institution of Gas Engineers, and *vice versâ*, for support and financial aid; sometimes the Institution, the Society of British Gas Industries, and the British Commercial Gas Association, have had to consult over matters of policy. In more than one instance, waste of time, delay, inadequate appreciation by parties, and a display of penuriousness (possibly through the want of substantial available funds) have been seen, when prompt and effective dealing with some question meant much not to one or a few gas undertakings, but to the whole of them. This unsystematic and unbusinesslike procedure wants to find its end in a representative central organization. Then let us get away, as quickly as possible, from any idea of sectional supremacy, regard the question imperially, and consider only the highest interests of the whole industry.

Each passing year has made the deficiency in organization more and more pronounced. The future must be considered in the light of this deficiency. There is a short article in other columns to-day by a new contributor. It is entitled "The Great Need of the Time;" and the author (who is closely connected with the administration of an important gas concern) has been induced, by the articles on "Central Organization" that have appeared in our last two issues, to put his thoughts before our readers. The article urges the industry to be prepared for what lies ahead—whatever may be its nature; and the most effective way of doing this is by bringing into the counsel of the industry brain power identified with all interests. The ideal Board of Gas Directors comprises not only technically qualified men, but men of financial, commercial, and legal talent, training, and experience. If such constitution is good for the direction of the affairs of a gas undertaking, how much more is such constitution needed in the supreme organization dealing with the multifarious affairs, and helping to

mould the policy, of the entire gas industry? We have to renounce the ideal in the case of the Board of Directors, if we deny its necessity and efficacy in the direction of the industry as a whole. And we can get in the membership of a central organization the best brains and the variety of talent and experience by admitting to it chairmen and directors and committeemen (so long as they hold office) and all chief executive officers, be their duties technical, commercial, or financial.

Our contributor, in surveying the situation and considering the future, sees that the time ahead will demand the strong central organization even more than the past has done. He finds in the capacity he holds that the industry has to contend with organized combination on every side. There are the Gas Coal Federation, the Tar Distillers' Association, the Alkali Manufacturers' Association, and so forth—the "so forth" embracing anything internal or external not specifically mentioned. He also finds the complacent idea prevailing that the stability of the industry is capable of withstanding the shock of every burden that others choose to impose upon it. This imposition of burden is extending; and it is a condition that must be, and can only be, effectively dealt with by a powerful and really representative organization. New questions, too, are ever arising. In competition, in finance, in legislation, in residual products development, and in investigating unsolved technical problems, he sees roads paved and flanked by duties and responsibilities pertaining to the industry in its entirety, and waiting proper attention. Another matter which has struck many people is that the industry, strong as it is in the extent of its operations and the character of its productions, appears with monotonous regularity to be on the defensive, and never ready to take the offensive. Good work has been done by the existing organizations; but there are the recognized deficiences. The causes of the whole of these deficiencies are insufficient representation of interests, divided responsibility, overlapping of activities, and lack of power to commit to a definite policy, without consulting—whom? Boards of Directors and Committees! Then they, with all others of influence and experience, are required in the central organization. "The intellects," writes our contributor, "which employ and control specialists " in chemistry, engineering, financial, and commercial sub- " jects, will do well to confer in central organization, and " not leave the future to take care of itself. The influence " and power of the full weight must be employed as a whole " on questions of general and vital import to the industry."

Special Control Boards for Statutory Industries.

In a paper read before the Institution of Electrical Engineers, Mr. Ernest T. Williams has put forward a plea for the establishment of a Board of Control for Electricity Supply. At present, the public control of the electricity industry is vested in Parliament, the Board of Trade, the Local Government Board, and the Home Office; and Mr. Williams holds that it is highly desirable for the maximum success of the electricity industry that the control should be co-ordinated by a central body directly responsible to Parliament. The idea is only new as applied to electricity. It has been put forward before in connection with Private Bill Legislation generally—particularly and emphatically has it been advocated in connection with the water supply of the United Kingdom. The plan long-since materialized in the establishment of Boards of Gas Commissioners in the United States. If *ad hoc* Boards were properly constituted for each statutory industry, they would supply the ideal system of prescribing, and amending as progress demanded, the conditions under which most public utility services are conducted at the present time. But without some proper constitution (which alone forms the real safeguard to the system), such Boards are almost bound to fail in performing their duties to the advantage of undertakings and community alike. Mr. Williams is proposing that his Electrical Board should be composed of a President and Secretary, electrical engineers and managers, a legal member, an accountant member, a financial member, and a parliamentary member. This seems to embrace all the requisite qualification. However, we have a long way to go before Parliament is likely to delegate its Private Bill legislative functions to such Boards—not that, we are inclined to think, Parliament itself would particularly object so long as new enactments and amendments of established ones were subject to its ratification. But Government Departments have shown themselves strongly averse to being stripped of any functions with which they have once been invested.

The Boards of Gas Commissioners in America have not been altogether a success; and this, we are afraid, is due largely to the academic side being strongly represented on them, and but little (if any) actual practical experience of the special work of the gas industry. The result has been that prescriptions and regulations have erred on the extreme rather than on the moderate or the equitable side. Unless the constitution of such a Board is leavened by technical and practical experience, the tendency is almost sure to be away from the line which marks the place of rationality and need. But even with such a Board, one does get, within the area of its jurisdiction, co-ordination of legislation; but there again, without specialized technical and practical experience, there is an inclination to rigidity in application of prescription and regulation without considering the individual circumstances of an undertaking. But in this respect there is little to choose between the American Boards and our own Parliamentary Committees. Private Bill Legislation is scored over with instances of irrational decision, which would have been avoided by a Board with two or three technically and practically qualified members in its composition; and innumerable are the decisions that show a greater fidelity to precedent and model than any judicial ability, through the ignoring of special individual circumstances of undertakings, which circumstances justly claim a departure from precedent or model.

On the whole, we should be prepared to support the formation of Special Boards to deal with the legislative work of each statutory industry, providing the constitution were right, and particularly as the whole of the members of such a Board would progressively become acquainted with the economic and practical needs of each industry, and so be able to render maximum and efficient service to the public. For the gas industry there is a large accumulation of legislative work requiring attention, such as the bringing of general enactment up to date, so as to facilitate and lighten the cost of applications to Parliament, the superseding of the irrelevant by the relevant, and the irrational by the rational, and the supplanting of past injustice by justice. If this could all be done by a competent Board, then the sooner the advent of such a Board, the better. But the change is not yet.

Moisture in Coke and Boiler Efficiency.

As will be seen from the report of the proceedings at the meeting of the Primitiva Gas Company, Limited, published in our "Miscellaneous News" columns to-day, Argentina has, owing to the war, suffered severely from the difficulty of obtaining coal, and from high prices and rates of freight. In consequence, large coal users have had to adopt fuel to which they are unaccustomed, and for the use of which, as in the case of steam-boilers, the plants have not been specially designed or fitted. Gas coke has been in large request; but for the highest attainable steam-raising efficiencies with coke, boiler plants require to be either specially designed or suitably equipped, so that the coke can be burned efficiently at high temperatures. This should be borne in mind by electricians who read the extremely interesting article, contributed to the "Electrical Review" (and which we reproduce by the courteous permission of the Editors), by Messrs. Pakenham Beatty and A. F. Smith, on the effect of moisture in gas-coke on boiler efficiency. The results set forth in the article were not obtained on an experimental scale, but were actually realized in everyday practice during the consumption of 10,000 tons of gas coke in a boiler-house of a tramway power station in Buenos Ayres. It is obvious there was no preparation whatever for the utilization of the coke; there was simply the change from the use of Welsh semi-anthracite coal to coke in marine-type hand-fired boilers, which, of course, means irregularity in feeding, which, in turn, does not conduce to the best results. With other boilers fitted with automatic stokers, there were difficulties; but this is a matter that is receiving the attention of boiler makers in view of the prospect of a large future development of the use of coke for boiler firing. Then, further, it is remarked that, owing to the ample capacity of the boilers, the furnaces were not equipped for forced draught; and this is with coke a distinct bar to the attaining of the best efficiencies. Again, with such a hygroscopic fuel as coke, the climatic conditions are adverse. Torren-

tial rains are experienced in Buenos Ayres, and the humidity of the atmosphere is high; and consequently this has an unfavourable effect on the moisture in the coke. Therefore, the results that Messrs. Beatty and Smith present in their article must not be taken as standard ones from the efficiency point of view.

Efficiency apart, the feature of the article is the effect that the authors found the moisture content of the coke had on the boiler efficiency. But this effect must only be taken as applying to coke used under the stated conditions. Even in this respect, the differences would unquestionably have been narrowed-down had forced-draught apparatus been applied. With Welsh semi-anthracite coal used in these marine-type hand-fired boilers, the consumption per unit of electricity generated averages 2·74 lbs.; the calorific value being about 14,000 B.Th.U. per lb. The annual boiler efficiency is 62·5 per cent., including the coal required for banking the fires at night. A representative sample of the coke had a calorific value of 13,660 B.Th.U. The best results in respect of moisture effect were obtained when the coke contained only 6 per cent. of moisture. After making deductions for the increased percentage of incombustible matter found in practice, and for the amount of water present, the evaporation corresponded to a boiler efficiency of 62 per cent., which was only ½ per cent. short of the efficiency when using the semi-anthracite coal. But with 20 per cent. of moisture, the highest efficiency was only about 55·6 per cent. The average result, with the varying moisture content, was 57·6 per cent. It is obvious that if gas coke is to be permanently successful as a fuel in steam-raising, its producers must give attention to the reduction of the moisture to a reasonable maximum—seeing that users will not want to pay for a percentage of moisture which has a disastrous effect on their boiler efficiency; for this means not only the disadvantage of a lower evaporation duty, but an increase of the fuel bill. For instance, under the conditions of this experience in Buenos Ayres, a 10 per cent. rise of moisture over 6 per cent. meant a 24 per cent. increase in the fuel bill. For a comparison with the efficiencies mentioned in the paper, reference may be made to the lecture delivered to the London and Southern District Junior Gas Association by Mr. E. W. L. Nicol, as published in the "JOURNAL" for March 28. He does not appear to mention the moisture content of the coke or coke breeze used. But the boiler was of the Cornish type, and fitted with the London Coke Committee's blowers. With coke, the boiler gave an efficiency of approximately 85 per cent.; and with coke breeze, approximately 80·9 per cent. Messrs. Beatty and Smith will see from these figures the difference in efficiency that a forced draught equipment would have had on their results; and on efficiency even with a rise of the moisture content above their standard of 6 per cent. With coke breeze, experience, under the circumstances of the Buenos Ayres boilers, was not favourable. But it is obvious that in every respect both coke and coke breeze were placed at considerable disadvantage through the conditions of use. Even under these conditions, the authors agree that their experience proves that both materials would be excellent fuels under "happier conditions"—the "happier "conditions," we take it, being those that are designed for the efficient burning of these fuels. The authors might also have spoken of the benefit of using a smokeless fuel, with no air-polluting smoke from the boiler-house chimneys, and of the fact that coke does not produce a carbonaceous deposit on the boiler tubes.

Two points are mentioned by the authors as being in the nature of drawbacks. One is that there is trouble through the amount of ash demanding the expenditure of more labour and time in cleaning. What is wanted is a grate that can be mechanically cleaned. Here there is good scope for the ingenuity of inventors. The other point (but this is not important, save where there is great pressure on space) is that 1 ton of coke, with a 6 per cent. moisture content, occupies 2·45 cubic metres of space against only 1·1 cubic metres for a ton of Welsh coal—that is to say, the coke needs 2·25 times the space for an equal quantity of coal. Of course, this means that with hand labour, the greater bulk in proportion to the weight entails a heavier amount of labour on the stokers. Notwithstanding these drawbacks, we are convinced that if Messrs. Beatty and Smith could give gas coke (to which they must be grateful for helping to tide them over a difficult period) a better chance by adapting the boilers to more suitable conditions for its combustion, they would assuredly have a tale to tell that would have a decidedly better complexion.

Co-Partnership in Gas.

Of the seven new co-partnership schemes which, during the year ended June, 1915, were added to those already in existence, three were in connection with gas companies—a very high percentage, though not a large number. Readers are aware of the prominent position which the gas industry, under the leadership of the late Sir George Livesey, has all along held in the movement; but it is none the less gratifying to see the statement frankly made in the annual report of the Labour Co-Partnership Association that "the chief industry in which co-partnership has been widely adopted is the gas industry carried on by public companies." Some notice of the report appears in another part of this issue; and it shows that, in all, 43 gas companies have adopted profit-sharing. Allowing for amalgamations, and a single case of abandonment, there are now 38 companies which come within the category of profit-sharing undertakings; and the position of individual schemes, as well as the aggregate results, are set forth in a table. When the report was being considered at last week's annual meeting of the Association, it was remarked by the Hon. Secretary (Mr. Aneurin Williams, M.P.) that the showing made by the gas companies was a very satisfactory one indeed. In the one case in which the principle had been abandoned after adoption, it was dropped so soon that it was of no use at all as a test. While the gas industry is so well to the fore in this matter of co-partnership, the numbers quoted show how much room there still remains for the addition of further names to the list. It will be seen that a second name has been added to profit-sharing in municipal work—the Borough of Burton-on-Trent having in this respect followed the example set some years ago by the Stafford Corporation. Other municipalities might well consider the advisability of putting into practice co-partnership principles. In view of the labour problems which will undoubtedly present themselves for solution at the close of the war, the Association regard the present as a particularly opportune moment for considering the question of the adoption of co-partnership in industry.

Excess Counsel and Expert Witnesses.

The retaining of an excessive number of counsel and expert witnesses in parliamentary, local inquiry, and arbitration proceedings does not meet with the approval of the Local Government Board. The high expense of promotion and opposition is a perennial cause of complaint; but the fault is at times due to those who make the complaint. Often there is to be seen before (say) a Parliamentary Committee quite a long array of counsel representing one side or the other of a case, and some of whom never as much as open their mouths, and are never observed to make a note. Likewise, too, such a number of expert witnesses are retained that before half of them have been in the witness chair, members of the Committee have been surfeited with the testimony; and, if they do not indulge in such a discourteous act as yawning, they get near to doing so. Sometimes Chairmen of Committees do show—it cannot be much wondered at—a little irritability at the repetition of evidence. It is a great mistake to overdo a case in this way. In a multi-featured case, it is, of course, necessary to secure good evidence on each point; but, apart from this, it is often felt that an excess of counsel and witnesses are only retained with the object of rendering them unavailable to the other side. These are days of economy; and now that the Local Government Board have drawn particular attention to a case in which they consider that there was undue expenditure upon counsel and expert witnesses, it may be taken for granted that there will be in other quarters disapprobation of similar acts. Though in some cases of arbitration it is now frequently decided to reduce expenditure by limiting arbitrators, counsel, and experts, regulation could not well be applied in all instances of arbitration, parliamentary proceedings, or loca inquiry. Extent of interests involved and the variety of subject-matter must be the ruling factors in each case; but there should be reasonableness—a sufficiency, but not an unnecessary surplus.

The Illustration.

The case in which the Local Government Board have shown their disfavour of extravagance is that which had for its object the amalgamation of Plymouth, Devonport, and Stonehouse. The Plymouth Corporation applied for sanction to borrow £17,000 with which to defray the costs of the parliamentary proceedings

and the local inquiry. The Board declined to sanction £1821 of the loan, which sum represented the cost of three of the Counsel engaged—no less than nine Counsel being retained by the three authorities. The Board regarded this as unreasonable. Then, though they have not deducted anything for expert witnesses, they point out that they have had the greatest difficulty in declaring that the whole of the expert evidence engaged was reasonable; and they express disfavour of lavish expenditure of the rates in procuring evidence of experts who have no particular claim to local knowledge of the subject of their evidence. For instance, the Board state that they would have been satisfied to decide the case with such evidence as to the financial position of the authorities concerned as could have been given by the local officers, and with similar evidence as to the medical and health aspects of the case. Whatever may have been the position in this instance, the ruling of the Board should not be allowed to have general application. The experience of experts in such matters as finance and health range over a variety of conditions which gives them the ability to investigate, criticize, and recommend in a manner which the man with purely narrow local experience could not possibly do with equal effect. As a matter of fact, the local officer frequently gets into a groove from which nothing but competent criticism will disestablish him. Therefore it cannot be taken that the views of the Local Government Board in this particular can be held to have common application, although we hope that they will have effect in putting an end to the extravagance in counsel and expert witnesses that is seen in so many instances, and which helps to prolong proceedings to an inordinate and costly length.

OBITUARY.

Deep sympathy will be felt with Mr. HENRY HAWKINS, the Manager of the Limerick Corporation Gas-Works, in the great loss he has sustained by the death of his wife, which occurred last Friday. Some weeks ago, Mrs. Hawkins sustained injuries in a car accident—having been thrown on to the roadway through the falling of the horse.

The Derby Gas Company have lost their Chairman by the death of Colonel GEORGE GASCOYNE, who died on the 13th inst., at the age of 73. Colonel Gascoyne (who was an Alderman of the Derbyshire County Council) was an old Volunteer; and until he resigned under the age limit he commanded the 5th Battalion Sherwood Foresters (Derby Territorials).

Mr. FREDERICK BLAKER, whose death is announced, at the age of 94, had been connected with the business life of Worthing for the long period of over seventy years. For close upon forty years he was a Director of the Gas Company, in which he was one of the largest local shareholders. He remembered the introduction of gas as an illuminant into Worthing, previous to which the sea-front was lit by oil-lamps. A treasured possession was an illuminated address presented to him by the Directors of the Company, on his retirement from the Board, owing to advancing years, in 1908.

PERSONAL.

Mr. H. E. JONES was elected a Vice-President of the Institution of Civil Engineers at the annual general meeting on the 18th inst. Mr. CHARLES CARPENTER, D.Sc., was at the same time elected a Member of Council, and Mr. DUGALD CLERK, D.Sc., was re-elected a Member of Council.

Congratulations are offered to two members of the gas industry who have been elected for the ensuing year to the chair of their respective District Councils. Mr. C. FOSTER VEEVERS, the Secretary and Manager of the Northfleet and Greenhithe Gas Company, has been chosen as Chairman of the Northfleet District Council; and Mr. J. H. BUCKLEY, the Engineer and Manager of the Formby Gas Company, has been selected to fill the like position in the Formby Urban District Council. Mr. Buckley during his membership of the Council has served on a number of committees; and he has in other ways taken a very active part in the public life of the town.

Mr. CLARENCE HARRIS, Manager of the Maryport Gas-Works, has been appointed Works Superintendent under Mr. T. H. Duxbury, the Engineer and Manager of the South Shields Gas Company, in place of Mr. J. J. Merrell, who recently went to the Hornsey Gas Company as Works Superintendent. Mr. Harris was for some time with Messrs. W. C. Holmes and Co., of Huddersfield, after which he was appointed Assistant to his father with the Great Wigston Gas Company; and during the past 3½ years he has been Manager at Maryport. He is an Int.B.Sc., and was for three consecutive years prize man of the evening department of the Leicester Technical School of Science, and holds first class honours and medal in Gas Manufacture and Distribution under the City and Guilds of London Institute.

THE PARLIAMENTARY BAR.

IT is no doubt true, as is remarked by way of introduction to an article in the current issue of the "Fortnightly Review," that the public are very ignorant as to the Parliamentary Bar and its doings; and it will be as readily admitted that there is no one better qualified to dispel this ignorance than the writer of the article in question—Mr. J. H. Balfour Browne, K.C. His own opinion is that possibly if they did know they would be callously indifferent; but there seems to be no reason why some amount of general interest should not be aroused in such a matter as the duties performed by Committees of the Houses of Lords and Commons, if the effort made is of the right kind. Mr. Balfour Browne, for instance, succeeds in imparting a good deal of information on the subject of Private Bill Legislation; and those who read it will surely be interested in what he has to say. More articles written in the same vein would spread and strengthen this educative influence; and therefore it is to be hoped he will find time and opportunity to pen them.

It is, of course, known that in the comparatively short span of a busy parliamentary session the work thrown upon successful members of the Bar, and upon Committees, is excessive; but it is nevertheless a little surprising to learn it may be so excessive that "it is said of a somewhat recent leader of the Bar that he admitted that upon one occasion he had nineteen different cases to attend to in one day." The busiest times are those of speculative fever—such as has been witnessed in connection with railways, tramways, and electricity. Consideration is given to the question of competition; and reference is made to certain Railway Bills as showing the great benefit in some instances of competition to a trading or travelling public, and the doubtful advantage of it in others. The time is recalled when there was active competition between the railway companies which had lines between Edinburgh and Glasgow, with such cutting of rates that "a person going from the one city to the other was carried the whole distance for sixpence, while the fares to intermediate, and therefore non-competitive, stations, amounted in some cases to six or seven shillings. No doubt these were halcyon days for the Scottish travellers. Anything under cost price commends itself to that cautious and bargaining nation. But the railway companies, after a time, discovered the folly of their cut-throat competition, and agreed not to compete. Since then, no doubt, they have been taking back in fares from the public what they gave away with such a lavish hand in those foolish days."

Water Bills are discussed, and the author is on fairly safe ground in asserting that, instead of allowing towns to take whatever they were able to appropriate, it would have been better to consider the whole question of the water resources of the country and the present and future needs of the population—thus enabling justice to be done between large and small communities. "Many large communities," says Mr. Balfour Browne, making a hit at what is widely recognized as being a thoroughly bad practice, "have appropriated sources which yield more water than their present needs or future requirements can justify, and have become great water shops, selling water to the smaller communities, and in most cases making a profit out of them. It is in this way that the small end of the wedge of Socialism, which we call municipal trading, has been introduced, not only in relation to the supply of water, but in relation to the sale of gas and electricity. Not so long ago, the Birmingham Corporation made a profit of £70,000 a year out of their gas undertaking, which went in relief of rates, and enabled the Corporation to spend a great deal more money than they would have been allowed to do if all the burden had fallen directly upon the ratepayers' grudging pockets."

Then gas is dealt with, and we are given a peep at the far-off days when competition was rife and there were two pipes belonging to rival companies in streets where in many cases a single one would have done, and therefore there was often far more capital expenditure than was necessary. The companies perceived that this was not the way to arrive at "cheap gas" and consequently increased demand; and, failing to get Parliament to sanction a districting scheme in advance, the "gas companies, in spite of Parliament, agreed not to compete, districted London for themselves, and then Parliament passed an Act to make this small illegality legal." There is an explanation of the sliding-scale, with which "some clever person" is credited as being the inventor. While admitting that this system has a look upon it of great fairness, the writer of the article insists upon the necessity, if injustice to the consumer is to be prevented, of not fixing the standard price too high; and, further, he says, it must be remembered that fluctuations in the price of gas are not so much due to the excellent or negligent working of the undertaking as to the rise and fall in the price of coal and residuals. Mr. Balfour Browne's opinion of the notorious action of the alkali manufacturers in connection with the working-up of residuals of gas undertakings is that "there never was such a barefaced attempt to secure a monopoly for a particular trade;" and in the holding of this view he is not alone.

Electricity is the last branch to be referred to, as it was the latest in the field; and in regard to it the reader is told that early Private Bill Legislation was all on wrong lines, and that, as a matter of fact, the legislation with reference to London "is still in a state of chaos." These are only a few of the points that Mr. Balfour Browne touches upon.

THE GREAT NEED OF THE TIME.

[COMMUNICATED.]

ALTHOUGH the gas industry was founded at the close of the Napoleonic wars, probably its era will really only commence on the termination of the present world war. General legislation—introduced in 1847, with additions and amendments between 1870 and 1873—left far too much to private enactment, with its exorbitant cost of promotion. Also too much has been left to chance; too little to investigation and research; and nothing at all to organization.

The amount of capital sunk in statutory gas supply is 140 million pounds, producing an annual income of 35 millions, and the industry caters for over 7 million consumers, for each of whom 2·4 actual tons of coal per annum are purchased—the sale of gas amounting annually to 206,474 million cubic feet. All this involves great mental effort; and the detail of its commercial, financial, and technical ramifications, if reduced to writing, would fill many volumes.

In the present international upheaval, the gas industry is marking time; and it would act prudently to at once prepare for what lies ahead. In so doing, it stands to gain either way. If the immediate future is bad, resources must be conserved; but, on the other hand, if matters turn in the direction we all earnestly hope they will, the need for organization is even greater. The interregnum could not be better employed than by united effort in the welfare of the cause. The hour has, therefore, arrived for taking stock of the situation.

The industry has to contend with organized combination at every turn; and the idea seems to prevail all round that its stability is capable of bearing the shock of everybody's burdens. Combination in the selling of raw material, and in fact everything requisite in the conduct of a business catering for public necessity, demands combination for protective purposes.

Moreover, there are difficult problems in finance and general administration; questions concerning residual products, which means so very much to the industry's future welfare; legislative interest is as important as its attainment is unbusinesslike and costly; there are technical and financial questions galore, inseparable in a great measure, but equal in importance to success as is the industry's pressing need in the direction of research.

The foregoing are unquestionably duties and responsibilities which have been committed by Statute to gas directors and gas committees respectively through proprietors and local authorities acting on behalf of proprietors. Responsibility, therefore, cannot wholly rest with, or be assumed by, officers of gas undertakings—questions of policy being the prerogative of the directorate. The official holds office at the pleasure of his board or town council; and personal desire should be subservient to the policy of those in authority.

The altered money value will doubtless be a factor in future commercial direction. Its effects upon gas sliding-scales should receive serious consideration. Indeed, matters generally will require to be more closely scrutinized; works practice and method overhauled; departments linked-up; and overlap cut out.

Regulated monopoly has already given place to competition; and the call is to the path leading to the abolition of raw coal as fuel (and consequently smoke abatement) and the attainment of "A Thousand and One Uses for Gas." Any *dolce far niente* spirit on this question must be removed; and the intellects which employ and control specialists in chemistry, engineering, financial, and commercial subjects, will do well to confer in central organization, and not leave the future to take care of itself. The influence and power of the full weight must be employed as a whole on questions of general and vital import to the industry.

Emphasis should be given to the words of a well-known gas official: "It has well been said that 'the eternal unrest of the business man is the source of national prosperity,' and that spirit of unrest needs to be cultivated, both within the gas industry and without, to-day more than at any previous time in our history."

ELECTRICITY SUPPLY MEMORANDA.

A PAPER which, if it does not throw any fresh light on the subject of the limitations in light emission of various electric filaments *in vacuo* and in gas, has been read, by Dr. C. P. Steinmetz, before the Chicago Section of the American Institute of Electrical Engineers; and to the "Electrician" we are indebted for bringing it to notice. The usefulness of the paper lies in the simplicity and comprehensiveness with which, in comparatively narrow compass, the author states the position. He sets out by asking the question, Why could not the carbon filament be operated at a higher temperature, and thus at higher efficiency? If, instead of running at a temperature of 1800° requiring 4 to 5 watts per candle power, the carbon filament was raised to 2500°, the candle power would be doubled for the same watts. But there is a limitation; and it is that the carbon filament at 1800°—below the melting and boiling point—begins to evaporate, and the carbon vapour is deposited on the lamp bulb. With continuous evaporation, the filament gets thinner; and the temperature being reduced, the light becomes less. The deposited carbon vapour also obstructs the light. Tantalum, osmium, and tungsten are all metals of extremely high melting-points; but they have a characteristic advantage over carbon in that their rate of evaporation is much less at high temperatures. Tungsten, unlike carbon, can be run up high in the temperature scale (nearly to the melting-point) with very little evaporation. The melting or boiling point and the evaporation point have no necessarily fixed relation for different substances. Tungsten can be run at much higher temperature than carbon with the same evaporation, although the tungsten would melt before the carbon. Osmium is rare; and tantalum has been superseded by tungsten because the melting-point of the latter is much higher, and can thus be run at a higher temperature. The reason for the filaments of incandescent lamps being lodged in a vacuum has been to avoid the enormous loss of energy through heat conduction and convection were the globe filled with a gas. The use of a vacuum, however, is disadvantageous, because it facilitates evaporation; and thus sets a lower and less efficient limit to the temperature to which in practice the filament should be raised.

Limitations of Electric Incandescent Lamps.

Theory of the Gas-Filled Lamp.

The author goes on to explain causes and effects in connection with gas-filled lamps. He assumes that, instead of having a vacuum in a 100-watt tungsten lamp, it is filled with inert gas—say, nitrogen at atmospheric pressure. To maintain the filament at the same temperature as before would require more energy, because of the dissipation of heat by the gas. The pressure of the gas, however, causes the evaporation of the filament to be much less; and therefore the temperature can be raised still higher with an evaporation no greater than with a vacuum. In other words, the pressure heightens the boiling-point and lowers the evaporation rate for equal temperature. Dr. Steinmetz explains this by assuming the evaporation in a vacuum to be such as to limit the life of a lamp to 1000 hours at the temperature produced by 100 watts. Then with nitrogen at atmospheric pressure 200 watts could be used with the same rate of evaporation and blackening. But this would raise the temperature, so that while 100 watts will give 200 candles, 200 watts would give 600 candles, were it not—and here's the rub—that the nitrogen carries away a lot of heat from the filament. As a consequence, an additional 100 watts must be supplied to make up for this loss, and raise the temperature sufficiently to give the 600 candles. In this way, the candle power of the lamp has been increased from 200 candles with an expenditure of 100 watts to 600 candles for 300 watts with the same evaporation, blackening, and life, which means an increase in efficiency over the vacuum lamp from 1 candle per watt to 2 candles per watt. Of course, we know from photometrical experience that these efficiencies are not actually obtained. As to low-power lamps—say, one requiring 20 watts with a vacuum—if filled with nitrogen, the temperature could be raised, but the filament is so thin that the evaporation, even at the lower rate due to the gas pressure, would wear it away too fast. Furthermore, the percentage of energy lost through the gas is very much greater, because the surface of a thin filament in contact with the gas is much larger compared with its volume than in the large filaments of lamps of high candle power. While large lamps may be filled with nitrogen, in the smaller type of gas-filled lamps—say, 100-watt lamps—in which nitrogen would result in no appreciable gain, it pays, Dr. Steinmetz says, to use argon. To put the matter briefly, the higher efficiency of the gas-filled lamp is due to the gas pressure keeping down the rate of evaporation and permitting a higher operating temperature. So far as filament lamps are concerned, the worthy doctor does not think there is any likelihood of a substantial gain in efficiency. Nor does he hold out any hope of finding a material for filaments having a higher melting-point than tungsten; but there might be a chance of doing something better by incandescence obtained by passing an electric current through either a gas or a vapour.

Electricity Prices and Consumers' Resentment.

Light for light, gas leads in lowness of cost. It has always done so since the perfected incandescent mantle put in an appearance; and it still does so, with all the advance made in the efficiency of incandescent electric lamps. The increased costs of gas and electricity through war conditions have made really little difference to their relative positions so far as cost for a given illumination is concerned; but, in regard to heating, an increase in the price of electricity adversely affects it more than an increase of price does in the case of gas, as B.Th.U. are by gas thrown in bulk at consumers at a very modest charge. There has in consequence been greater resentment on the part of consumers at the advances in the price of electricity than there has been at those made in the price of gas. The Westminster City Council have shown their displeasure over the intimation of the St. James's and Pall Mall Electric Supply Company that they will be compelled to charge the Council 4d. per unit net for lighting purposes as from June 24 next. The form in which the displeasure has been shown is by the Contracts Committee instructing the City Engineer to report as to the practicability of substituting and using gas lighting, and the cost thereof, at those buildings now lighted by the current

supplied by the St. James's Company. The Gas Light and Coke Company, we have no doubt, have been happy in supplying a quotation, if one has been required.

Applause from Over the Way.

"Electrical Industries" looks with very envious eyes upon the British Commercial Gas Association. In a recent issue, it told the electrical industry, by holding up the activities of the Association to its admiration, what marvellous opportunities it has missed through not having created a cognate organization. Our contemporary is so enamoured of it all that we feel sure, if it were possible, it would like to take over, even at a very high valuation, the whole of the brains and system of the B.C.G.A. for the behoof of the electrical industry. It just happens that the machinery that has been created, and the manning of that machinery, cannot be spared by the gas industry. The electrical industry may try to imitate, but it cannot acquire. Our contemporary makes a catalogue of some of the doings of the Association; and, lumped together in this way, they certainly make a very brave and interesting show. There is almost a note of despair in the electrical comments. The extracts made from the report of the B.C.G.A., it is said, carry their own moral; and then: "They show that the electrical industry has lost, and is still losing, a great opportunity by closing-down its scheme for organized publicity. We shall probably be told that in the one field where the war services of electricity are most conspicuous—that of electric power—every supply undertaking has more business than it can command. But that is no reason why the vital importance of the service should not be explained for the benefit of the industry. And no one can assert with confidence that the industrial lighting field does not still offer some scope for development. Moreover, there is still a good deal to be done in the domestic field. The B.C.G.A. has not ceased or even reduced its publicity work among private consumers. It has used the economy campaign and the domestic servant difficulty as levers to raise the consumption of gas." Our contemporary is generous in its praise of the B.C.G.A.; but it is tactical praise. It wants, and wants badly, a B.C.E.A.

Gas Producer Plants and Steam-Turbines.

Some electrical engineers have dreamed dreams and seen visions of electricity generating stations becoming makers of bye-products, even as the gas industry. It was such a simple matter. Raw coal pitched under the boilers means waste and destruction of valuable constituents. The gas industry utilizes its coal so that gas, coke, sulphate of ammonia, tar, ingredients for high explosives, the bases for aniline dyes, chemicals, disinfectants, sulphuric acid, and other utilities are preserved to the world. Why should not, it has often been asked by electricians, the electrical industry do the same? Why should not the raw coal be charged into producers, gas be obtained, and similar commodities as realized by the carbonizing processes of the gas industry contribute to the revenue accounts of electricity undertakings. It would be so simple; and the gas could be used in gas-engines for the generation of current. It must have come as a shock to those who have hoped for the day when electricity would only be one source of revenue to the electricity industry as gas is to the gas industry to learn that the Accrington Corporation, who are the only authority in the country possessing a self-contained gas-driven generating station, have determined not to duplicate, as was intended, the gas plant, but to instal steam turbo-generators of a capacity of 4000 KW. So the gas-driven station is superseded by the turbine. The whole point, of course, is the ultimate cost of generation; and the steam-turbine is hard to beat when one gets above a certain output. The gas-engine is the correct thing for private plants and small central generating stations. Pending the finding of suitable materials for the construction of gas-turbines, why not utilize gas or coke for raising steam for use in turbines? There are some large electricity-generating stations using waste gases to-day for steam-raising; and there are some substantial electricity-generating stations using coke for the same purpose, with forced-draught arrangements fitted to their boilers. If the generating-station is of sufficient capacity for the use of steam-turbines of a size that will turn out cheap electrical energy, then the destruction and waste occasioned by using raw coal can (if the waste lies heavily upon the conscience of the electrical engineer) be avoided by employing coke as fuel, and seeing that the boilers are properly fitted for the purpose.

Small Stations and Gas Leakage.

Mr. L. J. Lawless recently read a paper before the Engineering and Scientific Society of Ireland on "Small Electric Stations," in the course of which he is said to have "demonstrated" that where electricity has been installed in competition with, or in substitution of, gas-undertakings, electricity supply is profitable. No figures are given in the paragraph before us to show how this profitableness is attained. The financial records of not a few established electric undertakings—small to large—have exhibited anything but a satisfactory lucrativeness. So that it is a little bit strange, unless there is something radically wrong with the older established undertakings, if these very small concerns (which are small because the district corresponds, and therefore cannot offer a good continuous load, or diversity of demand on the plant) can be made profitable, while the others cannot be. Mr. Lawless takes as an illustration the town of Rathkeale. We have not previously had any acquaintance with this place, and do not fancy the rest of the world has its eyes upon it. It seems, however, that, according to the computations, where the gas undertaking could not previously make a profit on gas for public and private lighting, electricity has been able to do so. It is not stated in the somewhat vague paragraph whether the gas undertaking has been scrapped, or what has happened to the invested capital. Then we come to what is a point of exaggeration if intended to apply generally; if intended to apply to Rathkeale only, then, if true, one need not be surprised at the gas undertaking being a financial failure. It is stated that Mr. Lawless "pointed out that in the use of gas nearly one-third of the amount generated was unaccounted for, chiefly due to losses through leakage in the supply mains." This is a very bad state of things. But it is not the general state of things. Gas engineers do not think they are working altogether efficiently in the distribution system if their unaccounted-for gas aggregates more than (say) 5 per cent.—not 33⅓ per cent. The latter figure more nearly approaches electrical distribution losses than the 5 per cent. Unaccounted-for gas, our electrical friends should understand, is the product of not only leakage, but other causes—such as difference of gas temperature between the station meter and the consumers' meters, condensation, consumption in the case of street lamps being largely computed and not measured, meter errors, main leakages, and so forth. But a 33⅓ per cent, loss! Well, no gas undertaking deserves to make a profit, or even to live, if it cannot look better after gas produced by coal costing as much as that delivered in Ireland. It is an extraordinary waste; and it is not cheap gas that is wasted.

THE APPLICATION OF ELECTRICITY TO EXHAUSTER DRIVING.

By H. C. Widlake, M.J.Inst.E., of the Plymouth and Stonehouse Gaslight and Coke Company.

(*Continued from p.* 129.)

Supervision.

The degree of satisfaction with which any power plant operates is largely dependent upon the nature of the supervision and the qualifications of the man in charge. On small works having (say) one electrically operated stoking machine and a couple of conveyors driven by motors, there is, of course, not the same necessity for a highly qualified engineer in charge as exists on a works having a large electric power load scattered over a wide distribution area, and supplied from a central generating station. On the other hand, however, it is necessary that even the small works should have on its staff a good working electrician, as it must be remembered that so far as the stoking machine is concerned, such a works would have, so to speak, all their eggs in one basket, and would, in all probability, not have a second machine on which to fall back in case of a breakdown; so that there is the most vital necessity that the single machine should be maintained in an efficient condition. Where an electrical man is not kept, outside assistance has to be procured in the event of an electrical breakdown; and, apart from the fact that such assistance is always expensive and not always efficient, the interruption in the operation of gas making, or the diminution in the makes due to the necessity of resorting to hand firing while such assistance is being arranged for, will be responsible for indirect losses which would go a long way towards paying the wages of a fairly good working electrician.

In connection with the subject of this article, it is taken for granted that an undertaking which places its exhausting plant under the charge of the electric drive takes this step as the natural result of an extensive turn-over to electrical operation in respect to various other units of the gas-making plant. On such a works the electrical system is sufficiently extensive to warrant the employment of a well-qualified engineer in charge of the electrical plant. Such a man, by virtue of his training, is able to detect incipient defects in a machine which to the average attendant may seem to be working perfectly, and to remedy the same before they assume serious proportions, and, by their development, lead to an ultimate breakdown, which, in a works running without efficient supervision in this respect, has usually to actually take place before it is realized that there is anything wrong.

Reliability.

The proved reliability of the old single-cylindered steam-engine is largely responsible for the wide application of this machine for the driving of rotary exhausters. For the purposes of economy at light loads these engines are sometimes fitted with expansion-valve gearing, and for the driving of large exhausters on works where a supply of high-pressure steam is available compound engines are sometimes used. But in the very great majority of cases the work is performed by a single-cylindered non-condensing steam-engine. While this machine is undeniably a steam eater, it is, above all things, reliable—a factor which is of paramount importance, and one which cannot, in any degree, be sacrificed on the altar of low running costs. When steam-engines are used for the purposes of exhauster driving, it is usual to regulate the pull on the hydraulic main by means of a bell governor fixed adjacent

to the engine valve-chest and connected by suitable transmission gearing to a balanced throttle-valve on the main steam-pipe.

Gas-engines are used for exhauster driving to some extent, particularly upon small works; and while these engines have been proved to be equally as reliable as the steam-engine, they are not suitable for this class of work on installations in which the throttle method of governing is favoured, as their use necessitates the employment of the bye-pass compensator method for the regulation of the pull, on account of the fact that they do not possess in anything like the same degree the flexibility of speed control which is a characteristic of the steam-engine.

Both these methods of exhauster governing have their firm adherents, and both are equally applicable to an electrically operated exhausting plant. When considering the relative claims of the electric motor and the steam-engine for this drive, we have first and foremost to look at the matter from the standpoint of reliability. Outside the works, in dealing with electrical power competition, it becomes apparent to the gas engineer that the electric motor is not so reliable as either the steam or the gas engine; while the statistics of the leading machinery insurance companies go to prove that the percentage of breakdowns among insured electric motors is greater than that same percentage among insured gas and steam engines; and these considerations alone tend to make him rather reluctant to place at the mercy of the electric drive so important a unit of his plant as the exhausters. In this connection, however, we have to take into account the fact that, in all probability, the majority of the motors in respect to which claims are made on insurance companies are not under expert supervision, and, with the exception of the periodical visits of the insurance company's inspecting engineer, are never looked at by a man whose business it is to understand the machines and to recognize in them the existence of incipient faults.

Of late years another factor has cropped-up which must have a distinct bearing upon the matter, and that is the extent to which gas engineers, all over the world, are placing their most important machines in charge of the electric drive. Reverting to former argument, it is quite apparent that, so far as absolute reliability is concerned, there is a great difference between a motor, usually neglected and uncared for, on the average small power consumer's premises, and a machine which is always under the eye of a qualified power plant engineer.

By far the greater percentages of motor troubles on a well-maintained plant are due to under-rating—a form of abuse to which no power generator is so subjected as is the electric motor. Certain types of electric motors have a great capacity for dealing with overloads; and in placing an order for an electric motor it is not sufficient to specify that the motor must be capable of a certain continuous output. If immunity from trouble is desired, the question of the ultimate temperature rise must be gone into, and the motor ordered should be guaranteed to carry a certain load for a certain time with a given rise of temperature in its windings. For instance, the temperature rise in a type of motor used to a large extent on our modern battleships is guaranteed not to exceed, in any part of the machine or windings, 70° Fahr. immediately after a six hours' run at full load. The effect of an overload on an electric motor is purely a thermal one—the rise in temperature being proportional to the amperage passing through the windings and the time; and any attempt to run a motor continuously on a load in excess of its rated capacity expressed on a thermal basis is bound to set up a process of slow deterioration in the windings, and lead to an ultimate short-circuit and total destruction of the insulation.

Economy.

The degree to which the interests of economy will be served by the application of the electric drive to the main exhausters will depend largely on the general lay-out of the plant, its condition, the rate per B.o.T.U. at which electricity can be either purchased or, as is far preferable, generated on the works, and the manner in which the works steam-generating plant is arranged. For many purposes a supply of steam power is essential on a gas undertaking; and in cases where this supply is derived from the same battery of boilers as are used for the working of the existing steam-engines driving the exhausters, it is, of course, essential that, even after the turnover to the electric drive, one of these boilers will have to be kept under steam. But in any case, the reduced load on the boilers due to the change-over will greatly reduce the fuel, cartage, and possibly the labour charges.

On the other hand, where a battery of boilers is used exclusively for the driving of the exhausters, the alteration in the method of driving will permit of this battery being entirely shut-down, and the resultant elimination of all fuel, cartage, maintenance, and labour charges in connection with the same. So much depends upon the lay-out and the general arrangement of the plant, and the local conditions, that it is impossible to discuss this phase of the subject in any other than a general manner.

So far as the actual costs per B.H.P.-hour for the driving of the exhausters themselves are concerned, there is likely to be a considerable reduction in this respect, particularly when the application of the electric drive permits of a battery of boilers being shut down. The following figures give a rough comparison of the respective costs of driving by steam and electricity, and can be adjusted by the reader to suit any particular case which he may have under consideration.

Steam Drive.

From the economical point of view, the single cylindered non-condensing steam-engine usually employed for this class of work is notoriously inefficient. Some years ago a careful census was carried out in the neighbourhood of Birmingham in regard to the performances of a large number of steam plants; and, as a result of his investigations, Sir Frederick Bramwell stated that the average consumption of coal per I.H.P.-hour was 18 lbs. This, of course, seems an extraordinary figure; but when we consider the steam-eating propensities of these old simple engines, and the state of disrepair into which so many are allowed to fall, there is little doubt that it was correct.

The fuel used on practically all gas undertakings for steam-raising is coke or breeze, or a mixture of these two, depending on the situation of the works as regards surroundings, the class of grate on which the fuel is consumed, and the draught. Let us assume that, in the case under consideration, the steam consumption of the engine is 50 lbs. per B.H.P.-hour, and that for every pound of fuel burnt under our boiler we obtain an evaporation of 7 lbs. of water. This gives us a fuel consumption of about 7 lbs. per B.H.P.-hour; and assuming a fuel value of 18s. per ton on the works, our costs for fuel alone come out at 0·68d. per B.H.P.-hour. In order to obtain the total running costs, the following charges must be added to this figure: (*a*) Interest and depreciation, (*b*) insurance, (*c*) attendance, (*d*) fuel cartage, (*e*) water, (*f*) maintenance, (*g*) lubrication. These charges are in respect to both the engines and boilers; and where the latter are used for other purposes than the driving of the exhausters, the power costs in regard to the exhausters must be debited with a proportion of these charges, according to the ratio between the steam supplied for exhauster driving and for other purposes.

Electric Drive.

Let us assume that the electric motor used has an efficiency of 85 per cent. at the average load provided by the exhauster. The consumption of a D.C. electric motor having an efficiency of 85 per cent. will be 0·8776 B.o.T.U. per B.H.P.-hour; and assuming that the supply of electrical energy can be generated at a cost of 1d. per unit, the costs for current alone will amount to 0·8776d. per B.H.P.-hour. In order to obtain the total running costs, the following factors will have to be added to this figure: (*a*) Interest and depreciation, (*b*) insurance, (*c*) attendance, (*d*) maintenance, and (*e*) lubrication. In this case *a c d* and *e* will be considerably less than they would be in the case of the steam drive. As a matter of fact, the attendance charge would be almost eliminated, comparatively speaking, as in the case of the steam drive the attendance charges would chiefly consist, in many plants of moderate size, of the charges incurred in firemen's wages.

The four factors A, B, C, D [*ante*, p. 128], which have been dealt with, represent the considerations which should be gone into before any decision is arrived at in connection with the employment of the electric motor for exhauster driving. Assuming that the conditions outlined under these headings can be substantially complied with, the argument in favour of the electric drive for this purpose now turns upon the combination of plant which offers the greatest degree of reliability and flexibility. The direct coupling of electric motors to exhausters of the type under consideration cannot, except in the case of very small machines, be regarded with much favour, on account of the fact that the price of an electric motor varies inversely with its speed. For instance, an electric motor rated to give 25 B.H.P. at a speed of 1150 revolutions per minute would cost about £62; while a machine designed for the same output, but at a speed of (say) 190 revolutions per minute would cost about £165, would have a lower efficiency, would weigh between four and five times as much as the high-speed machine, and would occupy over twice the area.

In the last instalment of this article, the author proposes to show and describe three different methods of coupling exhausters for electric operation. In each case he will assume the motors to be 10 B.H.P. machines, and the exhauster speed to be 110 revolutions per minute.

(To be continued.)

Contraband of War.—There has been issued as a Parliamentary White Paper a complete list of the articles declared in the Proclamations now in force to be contraband of war. The list has been arranged alphabetically, so as to make it as convenient as possible for reference; and it comprises things which have been declared absolute contraband, as well as those held to be conditional contraband.

Semet-Solvay Coke-Ovens.—Attention has been called by the Coke-Oven Construction Company, Limited, of Sheffield, to a pamphlet which they have received from Japan, entitled the "Rise and Development of Semet-Solvay Coke-Ovens." The author is Mr. Kotaro Shimomura, who deals first with different systems of bye-product coke-ovens, discusses horizontal flues compared with vertical ones, and finally gives an illustrated description of the principle on which the Semet-Solvay oven is designed.

Hydrogen Gas for Heating and Illuminating.—Quoting the words of an Italian contemporary, the "Chemical Trade Journal" says: The use of hydrogen gas, obtained by electrolysis, is advocated by Sig. Carlo Velardi for lighting and heating, in substitution for, or mixed with, coal gas. The difficulties attending its use (the chief of which is its distribution) are easily surmounted; while the advantages from its employment, especially in a country like Italy, are great. Its utilization for heating and cooking purposes, he contends, is easier of realization than the replacement of coal gas by electricity.

THE EFFECT OF THE PRESENCE OF MOISTURE IN GAS-COKE FUEL.

By Pakenham Beatty, A.M.I.E.E., and A. F. Smith.

[Reproduced, by permission, from the "Electrical Review," to whom we are also indebted for the illustrations.]

The figures given in the following notes are based upon the results obtained in everyday practice during the consumption of 10,000 tons of gas-works coke in the boiler-house of a tramway power station in Buenos Aires.

Owing to the large stocks of coal it is usual to carry in Argentina, it was not until perhaps February, 1915, that the rise in the price of Welsh coal, following on the declaration of war by England, made itself felt. During February and March, Welsh coal, the normal price of which is about 33s. per ton c.i.f. Buenos Aires, rose to the unprecedented figure of 73s. per ton. Only in June, 1915, were first-rate American coals (such as Pocahontas, New River, and Georges Creek) obtainable at 45s. per ton c.i.f.; and although petroleum is actually found in Argentina, and a supply from Mexico has also been available since the commencement of the war, in the case of large installations where the capital required for the necessary modifications and additions to the plant represented a considerable sum of money, difficulty was experienced in making contracts at a convenient price for such a length of time as would warrant the expenditure involved.

Apart from the appreciable amount sold for domestic purposes in Buenos Aires, gas coke is also largely used in lime-kilns; but the general trade depression caused by the state of affairs in Europe reduced the consumption of this fuel to such an extent that it was placed within the reach of power-house engineers.

The generating station mentioned in these notes consists of two separate plants. The first and older section contains five slow-speed horizontal reciprocating engines, coupled to direct-current generators, giving a total output of 4500 kw., and nine Babcock and Wilcox marine-type hand-fired boilers, varying in size from 49 to 105 square feet of grate area. The total heating surface of the battery of boilers is 24,710 square feet, and the total grate area 651 square feet.

The annual production in units is about 16,800,000; and the average total steam consumption per unit generated, including that required for all auxiliaries, works out at about 20·94 lbs. A consumption per unit generated of 2·74 lbs. of Welsh semi-anthracite coal, with a calorific value of about 14,000 B.Th.U. per pound, gives an annual boiler efficiency of about 62·5 per cent. The above figure includes the fuel for banking fires at night, which amounts to approximately 3 per cent. of the total coal used. When coal is employed, a maximum of 22·37 lbs. per square foot of grate area per hour is burned, while the average during the twenty-four hours is 15 lbs. The annual feeder load factor works out to 49 per cent.

The second, or more modern, section of the plant contains two turbo-alternators, each of 1500-kw. capacity, and four Babcock and Wilcox land-type boilers, each of 76 square feet grate area and 4020 square feet heating surface, fitted with under-feed mechanical stokers. Economizers are not installed in either boiler-house, but exhaust-steam feed-water heaters are used.

Approximately 10,750,000 units per annum are generated by the turbo-generators, one of which is always running continuously at nearly its normal load. The coal consumption in this case is about 1·975 lbs. per unit; the steam consumption 17 lbs.; and the annual boiler efficiency 70 per cent.

An analysis of a representative sample of the gas coke used (made by Mr. A. Courtenay Luck, F.I.C.S.) gives the following results:

Elementary Analysis.		Other Data.	
[Sample dried completely at 110° C.]		Sulphur	1·51 per cent.
Carbon	88·15 per cent.	Volatile matter lost on heating away from air	2·96 ,,
Hydrogen	0·94 ,,	Calories per kilogram by Mahler bomb, dry fuel	7,589
Ash	9·81 ,,	B.Th.U. per pound	13,660
Oxygen and nitrogen by difference	1 10 ,,		

The calorific value obtained by the Mahler bomb agrees fairly closely with the calorific value as calculated by formula from the elementary analysis.

The coke was burned under the marine-type hand-fired boilers; and the average results obtained during the consumption of 10,000 tons are set out below:

Pounds per kw.-hour	3·675
,, of steam per pound coke as fired	5·7
,, of steam per pound coke from, and at, 212° Fahr.	6·72
Boiler efficiency, per cent.	57·6
Ash, per cent.	13·5
Moisture, per cent.	13·0

The ash, on being weighed as taken out of the boiler-house, after being quenched, was found to contain 20 per cent. of moisture. The best results obtained were with a large quantity of coke that contained 6 per cent. of moisture, when an average evaporation of 7·9 lbs. of steam from and at 212° Fahr. per pound of fuel, was attained during trials extending over a month. After making the necessary deductions for the increased percentage of incombustible matter found in practice, and for the amount of water present, this evaporation corresponds to a boiler efficiency of 62 per cent.

Assuming it were possible to maintain a boiler efficiency of 62 per cent., the curve in fig. 1 was drawn showing the evaporation from and at 212° Fahr. to be expected, taking into account both the increased percentage of incombustible matter in comparison with that set out in the analysis and the moisture present in the coke. As a result of subsequent trials, all extending over several days, a second or lower curve was constructed, showing the evaporation obtained in practice with varying percentages of moisture.

The loss of boiler efficiency due to the presence of moisture is also plotted on the curve. It will be noted that with 20 per cent. of moisture, about 55·6 per cent. efficiency is the highest that could be reached.

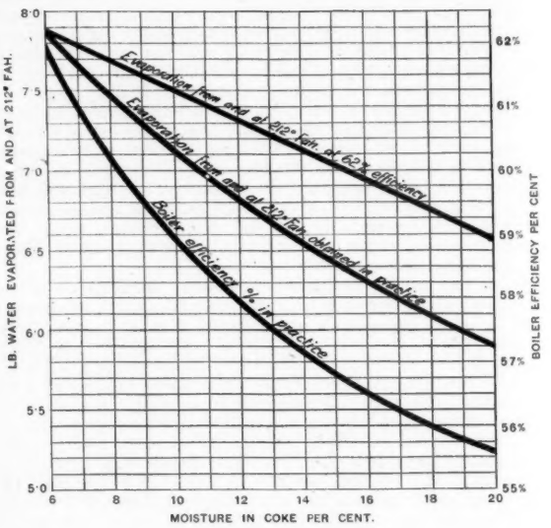


Fig. 1.

The curves in figs. 2 and 3 were plotted in order to show the enormous increase in fuel consumption per kilowatt produced, due to the combined effect of the drop in efficiency and the losses expected from the presence of moisture. From fig. 3 it is apparent that a 10 per cent. rise in moisture over the normal, which was taken at 6 per cent., meant a 24 per cent. increase in the fuel bill.

In the case of all the evaporation performances in practice given above, the amount of fuel employed for banking fires is included or (say) 3·5 per cent. of the total amount used.

It should here be mentioned that the climatic conditions under which the fuel was burned were exceedingly unfavourable to such a hygroscopic substance as coke. The extremely high percentage of moisture was found during periods when heavy rains fell, and the average relative humidity varied between 80 and 85 per cent. It would, however, appear that 6 per cent. was the minimum amount of moisture gas coke is likely to contain, even in dry weather. With this amount of moisture, 1 ton of coke occupied 2·45 cubic metres, as against 1·1 cubic metres in the case of the Welsh coal usually burned. In other words, 1 ton of coke occupied about 2·25 times more space than Welsh coal; and the extra work entailed was the cause of some complaint from the stokers.

The highest rate at which coke containing 6 per cent. of moisture was burned reached 18 lbs. per square foot of grate area per hour; but when the moisture rose to 20 per cent., as much as 23 lbs. per square foot of grate area had to be consumed, in order to keep pace with the load.

A sketch is given of the type of fire-bar employed—see fig. 4. As the ash-pits contain water-troughs, no difficulty at all was experienced in keeping the fire-bars cool. The ash formed was exceedingly troublesome to remove, forming a layer 1½ inches thick over the fire-bars that greatly hindered the passage of air through the fire.

In fig. 5 is given a CO_2 record that represents an average diagram. Frequent and careful tests made with an Orsat set only served to confirm the high percentage of CO_2, and failed to detect the slightest trace of CO.

As it was possible to keep the amount of coke burned per square foot of grate area per hour down to about 15 lbs. except during the short peak-load in the evenings, it was not considered necessary to

go to the expense of fitting forced-draught apparatus. All attempts to use coke in the automatic stokers ended in failure, owing to the burning of the bars and other parts of the stokers.

Extended trials made with coke breeze gave the following mediocre results—chiefly due to the extremely high percentage of ash that necessitated frequent supplementary cleaning of the fires by hand, on account of the impossibility of dealing, by means of the usual mechanical cleaning devices fitted, with this unusual quantity of incombustible material.

Pounds of breeze per KW.-hour	3·196
,, steam per pound of breeze as fired .	5·319
,, steam per pound of breeze from and at 212° Fahr. . .	6·282
Boiler efficiency, per cent. .	55
Ash, per cent.	17
Moisture, per cent. . . .	13

An analysis of the coke breeze is given below:

ELEMENTARY ANALYSIS.

[Sample dried completely at 110° C.]

Carbon	83·1 per cent.
Hydrogen	1·02 ,,
Ash	15·2 ,,
Oxygen and nitrogen by difference	0·68 ,,

OTHER DATA.

Sulphur	1·15 per cent.
Volatile matter lost on heating away from air . . .	2·60 ,,
Calories per kilogram by Mahler bomb	7,318
B.Th.U. per pound . . .	13,170

The endless difficulties experienced in attempting to obtain the efficient combustion of substances containing as much as 33 per cent. by weight of ash and moisture have not—as indeed might be expected—caused the authors' opinion of coke and coke breeze to be unprintable.

The few pleasant moments spent during the trials, even with the coke breeze, which on one occasion gave as high a boiler efficiency as 58 per cent., when things went well, were sufficient to show what excellent fuels both coke and coke breeze might be under happier conditions.

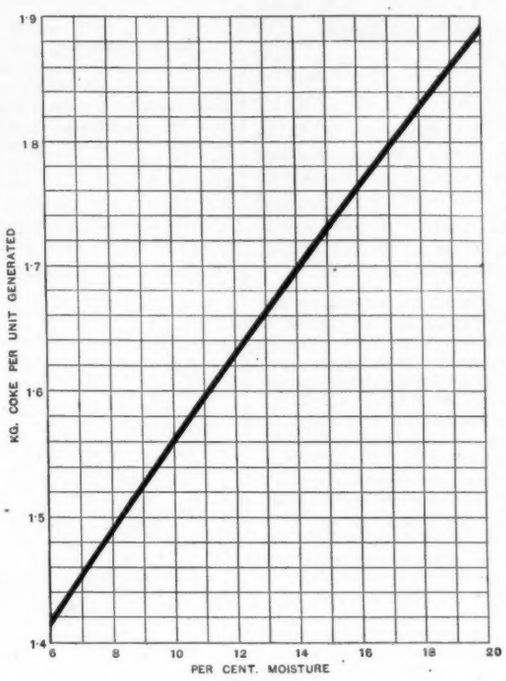


Fig. 2.

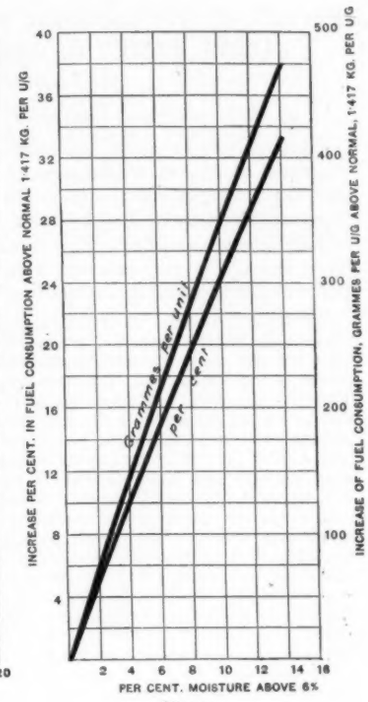


Fig. 3.

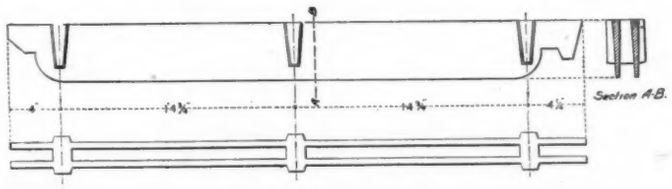


Fig. 4.

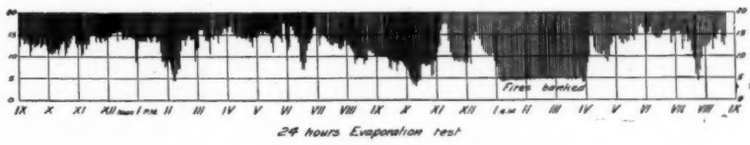
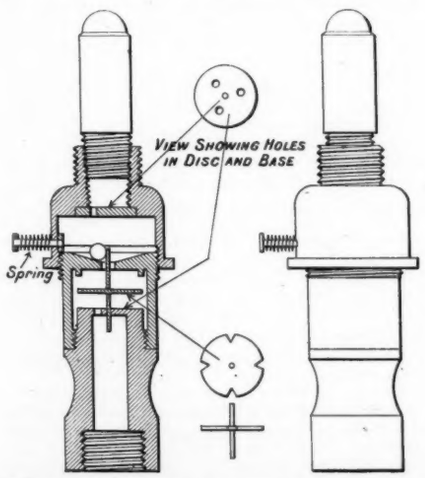


Fig. 5.—Percentage CO_2 Record.

AUTOMATICALLY CLOSING GAS-BURNER PIPES WHEN THE SUPPLY FAILS.

Mr. George Wilson, of Foleshill Road, Coventry, writes to point out that "it is becoming more and more evident that the best precaution against Zeppelin raids is to plunge the whole country into darkness"—remarking: This, of course, can be very quickly accomplished from the gas-works or power stations, but in the case of gas-works it has been realized that great danger will occur when the gas is turned on again, on account of open burners. For this reason his firm has brought out a special automatic gas-valve to be fixed between the burner and taps. Immediately the gas supply is cut off, the valve closes, thus closing the passage for the gas, so that when the supply is resumed no gas can pass to the burner till the valve is released by pressing a small button.



The sketch sent is reproduced the full size required for ordinary burners, and shows how simple it is, so that the cost will be exceedingly small. The valve was invented as a safety apparatus where taps might be accidentally left open as is sometimes the case where slot-meters and gas-stoves are used. An application for a patent for the contrivance was applied for some time ago.

According to the invention, at a point in the gas supply pipe—preferably adjacent or near to the burner—is arranged a small chamber provided with inlet and outlet openings for the passage of gas. The inlet opening is governed by a small valve, which is sufficient when closed to prevent gas entering and reaching the burner. The section shows the inlet and outlet chambers and a light disc with a pin attached. When the gas is turned on, the spring-controlled plunger is pushed inwards with the finger, and moves a ball off its seating—thus allowing free passage for the gas to the burner. The gas flowing through the chambers causes a finely-balanced disc to float, bringing the pin in the valve opening, and preventing the ball from falling in its seat. Directly, however, the flow of gas is stopped, the disc drops, and allows the ball to fall in its place and close the gas passage.

The pressure of gas, when turned on again, is not sufficient to unseat the ball; and so the gas passage to the burner is shut off and cannot be reopened till the operation described is repeated.

"Some Further Uses of Gas in the War" are described and plentifully illustrated in the April issue of "A Thousand-and-One Uses for Gas," which is published by the British Commercial Gas Association. This constitutes the third "Industrial" number, and deals with gas in shell factories, &c., more fully than it was possible to do in the "Munitions" number last July.

EFFECT OF ATMOSPHERIC PRESSURE ON THE CANDLE POWER OF VARIOUS FLAMES.

By E. B. Rosa, E. C. Crittenden, and A. H. Taylor.

A paper giving a report of some investigations carried out at the Bureau of Standards, Washington, by Messrs. Rosa, Crittenden, and Taylor was presented at the Ninth Annual Convention of the American Illuminating Engineering Society last September, and has since been published in the "Transactions" of the Society. The paper is a lengthy one with a considerable number of diagrams. The following is a summary of its contents.

The authors review previous investigations, and reproduce the curve obtained by Messrs. Butterfield, Haldane, and Trotter in 1911 for the variation with barometric pressure of the candle power of the Hefner and Harcourt lamp flames [see "Journal," Vol. CXV., p. 228]. It is pointed out that while the possible error, due to the uncertainty in the correction factor for atmospheric pressure, in the normal value of a flame standard is very slight, so long as it is used at or near sea level, the candle power is considerably less when the flame standard is employed at higher altitudes. The paper states that the Bureau possessed no reliable data for calculating the candle power at such reduced pressures, and that no experiments had been made accurately enough to determine the correction co-efficients satisfactory even for commercial use. The natural variations in the barometer at one place are too small to give reliable deductions for pressures differing considerably. Having regard to the trouble and expense of carrying out considerable series of measurements on a variety of flame sources at test stations at different altitudes, the authors decided to construct an apparatus which would allow the measurements to be made in their own laboratory with variations of pressure corresponding to two or three miles range in altitude. The apparatus was also used to determine the effect of atmospheric humidity on candle power.

Description of Apparatus Used.

The apparatus, of which a diagram is shown in fig. 1, comprises two cylindrical tanks set on end, each 3 feet diameter and 5 feet high. The first tank, in which is placed the light on which the observations are being made, has a perforated wooden floor about 1 foot from the bottom to diffuse the incoming air, and a manhole cover, 15 inches by 30 inches, on one side. Above this is a shaft with fittings for adjusting from outside, through a glass window, the flame height of the lamp. About 90° round the tank is

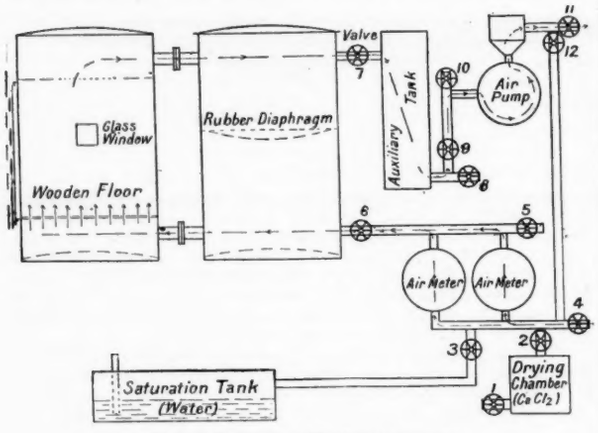


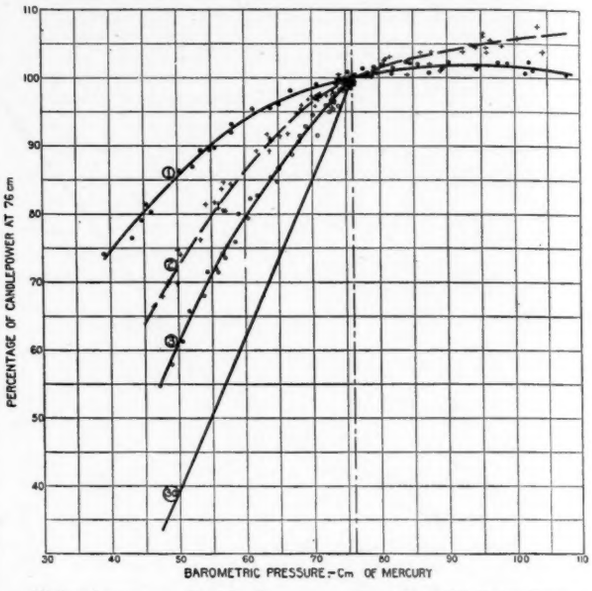
Fig. 1.—Diagram of Testing Apparatus.

another glass window, through which the light from the lamp within shines on the photometer screen. On the side opposite the window is a ventilating hygrometer with an electrically-driven fan drawing air from the bottom of the tank over the thermometer bulbs and discharging it at the top. A mercury gauge is provided to measure the pressure within the tank. About 15 inches below the top of the tank is a wooden partition with a hole about 16 inches by 25 inches, to prevent the return downwards of the products of combustion.

The second tank serves merely to equalize fluctuations or throbs in the air pressure; being connected at the top and bottom by 3-inch pipes with the first tank, and having a thin rubber diaphragm dividing it into halves about mid-height. The upper half is connected with a smaller equalizing tank. The lower half is connected with two air meters on parallel connections, a drying chamber containing calcium chloride, and a tank holding water for humidifying the air. Valves are provided to alter the course or direction of the circulation of the air. The arrows in the diagram indicate the course taken when the air of the room is being drawn through the meters and thence through the tanks. A Zeiss refractometer was used to ascertain if there were any increase of carbonic acid in samples of air taken in the first tank near the flame under test.

Effect of Variations of Pressure on the Harcourt and Hefner Standards.

The measurements of the Harcourt and Hefner lamps were made by substitution of a standard electric lamp against a comparison electric lamp, the voltages of both electric lamps being measured by a potentiometer. It was found by trial that there was no measurable effect on the light of the Harcourt lamp due to vitiation of the air, until the rate of flow of air, through the tank had been reduced below 550 cubic feet per hour. A rate of flow of 700 to 800 cubic feet (at the tank pressure) of air per hour was therefore adopted in the investigations. Observations of candle power, each the average of about 75 settings of the photometer, were made on the Harcourt lamp at pressures



1. Hefner Lamp. 2. Pentane Lamp. 3. No. 7 Bray Slit-Union Burner.

Fig. 2.—Variation of Candle Power of Certain Flames with Barometric Pressure.

ranging from 463 to 1072 mm. (18·2 to 42·2 inches). In the Hefner lamp observations, the rate of flow of air was kept below that at which the steadiness of the flame began to be affected. The Hefner flame was steadier in the tank than in the open air, and it would therefore appear desirable to use this lamp in such a ventilated enclosure in cases where the highest degree of accuracy is aimed at. Both the Harcourt and Hefner results were corrected to standard humidity—viz., 0·8 per cent. by volume of water vapour for the former and 0·88 per cent. for the latter. The results obtained are given in the curves 1 and 2 of fig. 2.

Effect of Variations of Atmospheric Pressure on the Light of Gas-Flames.

Observations were made of the effect of variations of atmospheric pressure on the light of: (1) Sugg's "F" argand, (2) Bray's No. 7 slit union, and (3) Von Schwarz's No. 8 "E. H." burners. The burners were tested with the rate of consumption set as nearly as possible at 5 cubic feet per hour at the pressures and temperature obtaining in the tank; and when the rate differed slightly from this, a correction was made for the difference in efficiency of the burner at the two rates. This correction was determined by a preliminary series of observations at two or three different pressures and at varying rates, from which observations curves were plotted showing the efficiency of the burner at different rates in terms of the efficiency at 5 cubic feet per hour. These curves are reproduced in figs. 3 and 4. The results of the observations on the variation of the light from the burners with atmospheric pressure were plotted, after due correction, as percentages of the light afforded by 5 cubic feet of gas, measured at 30 inches and 60° Fahr., and burning in air at 760 mm. barometric pressure. The curves reproduced in fig. 5 were thus obtained. The curve for the Bray No. 7 slit union burner is reproduced also in fig. 2 for ease of comparison with the curves obtained for the Harcourt and Hefner lamps. The curve 3*a* in fig. 2 is for the same burner when consuming 5 cubic feet of gas measured at the atmospheric pressure prevailing in the tank. It will be seen that the open gas-flame decreases in light, as the pressure falls, more rapidly than the Harcourt lamp, which again shows a more rapid decrease than the Hefner lamp.

Reason why Atmospheric Pressure Affects the Light of Flames.

Barometric pressure affects the rate of diffusion of oxygen through the burning fuel in the flame; the rate of diffusion increasing as the pressure falls. Thus the glowing particles of carbon set free in the earlier stages of combustion enter on the later stage of complete oxidation more quickly, and consequently

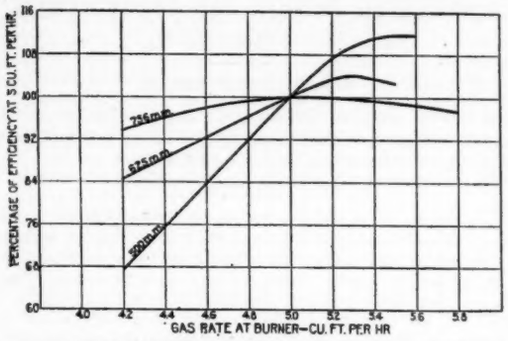


Fig. 3.—Variation of Efficiency with Consumptions at Different Pressures of a Sugg "F" Argand Burner.

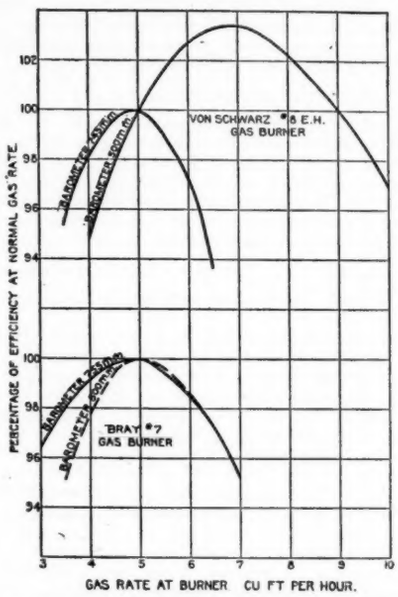
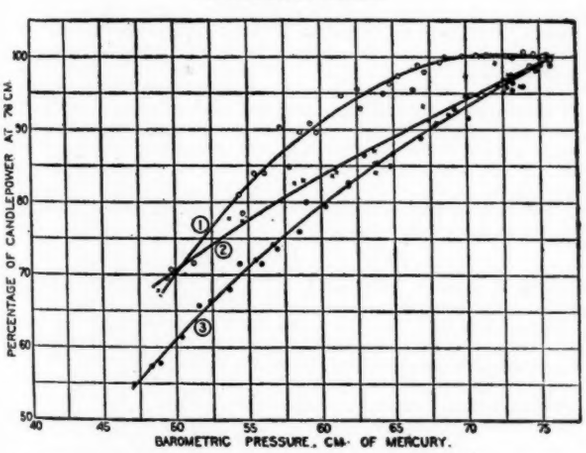

VON SCHWARZ "8 E.H. GAS BURNER
BAROMETER 675 m.m.
BAROMETER 500 m.m.
BRAY "7 GAS BURNER
BAROMETER 725 m.m.
BAROMETER 500 m.m.
PERCENTAGE OF EFFICIENCY AT NORMAL GAS RATE
GAS RATE AT BURNER CU FT PER HOUR.

Fig. 4.—Variation of Efficiency with Consumptions at Different Pressures.



1. Sugg "F" Argand Burner. 2. Von Schwarz "No. 8 E. H." Burner. 3. No. 7 Bray Burner.

Fig. 5.—Variation of Candle Power with Barometric Pressure and Constant Mass of Gas.

the number of glowing particles in existence at one time is smaller, and the light emanating from them is correspondingly reduced. This reduction is, however, partly neutralized by the higher temperature which results from the more vigorous combustion arising from the more rapid access of oxygen. The higher temperature causes each carbon particle to emit more light, but only for the shorter time during which it is in existence. Thus a flame which is on the verge of smoking through excess of carbon may actually afford more light when the pressure is reduced by a little, though a point is soon reached at which the reduction in the number of carbon particles overbalances the effect of their higher temperature, and reduction in the light becomes more and more rapid as the pressure is further reduced.

Generally speaking, the whiter a flame is the farther is it from the smoking point, and the more rapidly does its light vary with change of pressure. Thus at a pressure of 20 inches the flames named gave only the following percentages of their light at normal pressure: Acetylene, 52; open-flame gas-burners, 63 to 72; Harcourt lamp, 73; Hefner lamp, 86 per cent. It will be noticed that the order follows the change of colour of the flame from white to red. The Von Schwarz gas-burner has a higher efficiency than the Bray No. 7 burner; and its flame being nearer the smoking point, it is affected to a less degree by changes of pressure. In the argand burner the chimney modifies the conditions of mixing of the gas and air. This burner passes its maximum efficiency as the flame comes to the verge of smoking, and the light falls off more rapidly than that of the open gas-flame when the pressure is considerably reduced.

Effect of Humidity on the Harcourt Lamp and Gas-Flames.

The effect of humidity on the light of the Von Schwarz gas-burner was ascertained by tests over a range of 0·6 to 4·5 volumes of water vapour per 100 volumes of dry air, and the results are shown in fig. 6 in comparison with results obtained previously at Washington for the Harcourt lamp. Results over a smaller range for

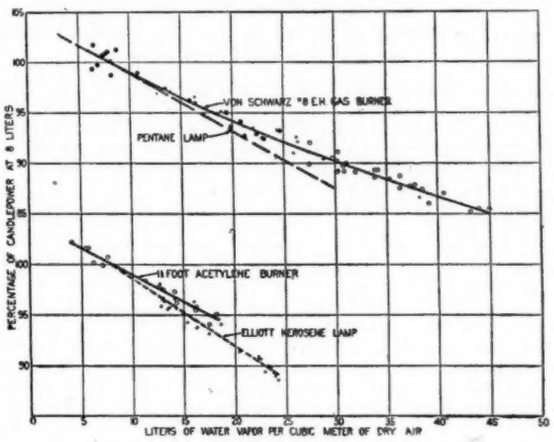

VON SCHWARZ "8 E.H. GAS BURNER
PENTANE LAMP
11 FOOT ACETYLENE BURNER
ELLIOTT KEROSENE LAMP
PERCENTAGE OF CANDLEPOWER AT 8 LITERS
LITERS OF WATER VAPOR PER CUBIC METER OF DRY AIR

Fig. 6.—Variation of Certain Flames with Atmospheric Moisture. (Barometric Pressure, 71 c.m.)

an acetylene flame and the Elliott kerosene lamp are included in the same diagram. At the lower degrees of humidity the curve for the gas-burner shows a decrease of 5 per cent. in light for each volume per cent. of water vapour in the air, as compared with 5·7 per cent. for the Harcourt lamp, and 6 per cent. obtained by Gilpin for an (unnamed) open-flame gas-burner.

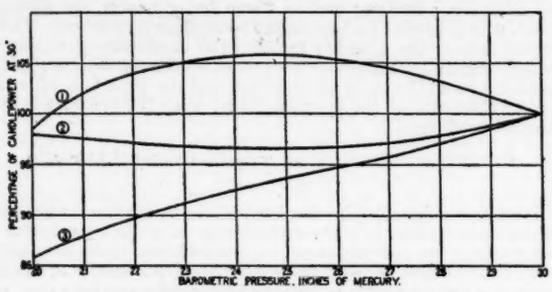
Effect of Atmospheric Vitiation on the Harcourt Standard.

A limited number of observations were made on the Harcourt lamp when burning in air of which the vitiation was gradually increased by the combustion of the pentane itself and of gas from several gas-burners. The proportion of carbon dioxide in the air at the time of each observation was inferred by drawing some of the air through a refractometer of which readings were taken at short intervals. The observations showed that an increase of 0·1 per cent. in the proportion of carbon dioxide in the air was attended by a decrease of 3·4 per cent. in the light of the lamp. Since, however, the decrease in light is primarily due to the reduction in the proportion of oxygen in the air, which bears no definite relation to the proportion of carbon dioxide unless the vitiation has been caused entirely by the combustion of a fuel of definite composition, this figure affords only a rough indication of the magnitude of the effect of bad ventilation. The magnitude is such that the difference between the three volumes of carbon dioxide per 10,000 in outside air and the six volumes which may be expected in a well-ventilated photometer room corresponds with a change of 1 per cent. in the light of the Harcourt lamp. Far more elaborate means of controlling the composition of the air would therefore appear to be necessary if a flame standard were taken as the basis of a fundamental unit of light intended to be exact within 0·1 per cent.

Bearing of Results on Gas Testing.

The authors discuss the effect of differences in atmospheric pressure on the results of testings of gas in which the Harcourt lamp is used as the standard of light. Their investigations on gas-flames were, however, made on a mixed gas—about 30 per cent. of coal gas and 70 per cent. of water gas—having a calorific value of about 630 B.Th.U. per cubic foot, and an illuminating power (flat-flame) of 20 to 23 candles. The conclusions apply strictly only to the testing of gas of this character and quality, and the curves given by the authors cannot be applied to make exact corrections for other grades. In testings with the Harcourt lamp on gas of the grade in question, the values which would be obtained from three different gas-burners—the volume of gas consumed being corrected to normal in the usual way—are shown

by the curves in fig. 7. Taking gas which when burnt in the Sugg "F" argand burner and tested against the Harcourt lamp affords a light of 20 candles when the atmospheric pressure is 30 inches, the curve indicates that in a place where the barometer stands at only 25 inches the same gas would be credited with an illuminating power 6 per cent. higher than 20 candles. Or again



1. Sugg "F" Argand. 2. Von Schwarz "No. 8 E. H." Burner. 3. No. 7 Bray Burner.

Fig. 7.—Effect of Barometric Pressure on the Candle Power of Gas as Measured in the Pentane Lamp.

taking gas which showed 20 candles at 30 inches atmospheric pressure in (1) the Bray No. 7 slit union or (2) the Von Schwarz No. 8 "E.H." burner, tests in the same burners under an atmospheric pressure of 25 inches, following the ordinary procedure of gas testing, would give illuminating powers respectively 6·5 and 3·5 per cent. lower than the 20 candles.

In order to demonstrate the application of the results obtained to the testings of gas in different localities, the authors ascertained the mean barometric pressure and mean humidity for five years (from 1904 to 1908) or eleven cities, and computed on this basis what value would be ascribed in these several places to gas which would have in normal atmospheric conditions—*i.e.*, 30 inches and 0·8 per cent. by volume of water vapour—an illuminating power of 20 candles. It is assumed that the gas would be tested in each place by means of the Harcourt lamp and the Von Schwarz burner, following the ordinary procedure of gas testing. The actual light afforded by 5 cubic feet of the same gas measured under the mean local atmospheric pressure has also been computed. The figures are given in the appended table:

Local Values of Normal 20-Candle Power Gas.

City.	Average Barometric Height.	Average Humidity, Per Cent. by Volume of Water Vapour.	Light from 5 Cubic Feet of Gas Measured in Average Local Conditions.	Illuminating Power which Local Testings with the Harcourt Standard would Assign to 20-Candle Power Gas.
	Inches.		Candles.	Candles.
New Orleans . . .	30·00	1·91	19·1	20·2
Washington (D.C.) .	29·94	1·20	19 7	20·0
Boston	29·88	0·99	19·9	20·0
San Francisco. . .	29·87	1·13	19·7	20·0
Chicago	29·15	1·06	18·9	19·8
Atlanta	28·84	1·43	18·3	19·8
Sioux City (Iowa) .	28·80	0·92	18·7	19·7
El Paso	26·19	0·92	15·8	19·4
Helena	25·80	0·68	15·6	19·3
Denver	24·73	0·79	14·4	19·3
Cheyenne	24·01	0·73	13·8	19·3

The authors observe that the figures in the last column show that the results obtained by correcting in the ordinary way do not necessarily indicate the quality of the gas supplied closely enough for a comparison of the production of gas plant in different cities. Neither are they an indication of the service which the consumer is receiving, which would be better represented by the figures in the penultimate column.

Two papers are down for reading at the meeting of the London Section of the Society of Chemical Industry, to be held at Burlington House, on Monday next. The first of these is the one by Mr. J. S. G. Thomas, B.Sc., A.R.C.S., on the "Evaporation of Naphthalene in Dry and in Moist Coal Gas," which was included in the programme for the last meeting. The second is an "Historical Summary of our Knowledge of Sulphur in Coal Gas," by Professor Frank Clowes.

In the course of a lecture under the auspices of the Engineering Society of Ireland, at the Royal College of Science, Dublin, on the "Development of the Suction-Gas Producer," Mr. H. V. Senior, of Lincoln, said that the conservation of Great Britain's coal resources was a matter of national importance, and that in endeavours to capture German trade no means of reducing the cost of power, and therefore of production, should be ignored. Germany had done a great deal in the development of economical prime-movers, and had gas-engines of thousands of horse power, but it could not claim the same credit as Great Britain in the development of the suction-gas producer.

SCOTTISH JUNIOR GAS ASSOCIATION.

(EASTERN DISTRICT.)

Annual General Meeting.

The Annual General Meeting of the Association was held in the Heriot-Watt College, Edinburgh, last Saturday; the chair being occupied by the President, Mr. James J. Scott.

The Membership.

The Hon. Secretary and Treasurer (Mr. Robert Scott) submitted the twelfth annual report of the Council, which stated that, considering the times, the session had been quite satisfactory from the membership point of view. There were 13 honorary and 73 ordinary members—being a decrease of one under each of the heads. As far as could be ascertained, 14 members had joined the Colours. One honorary member, Mr. Henry O'Connor, died for his country; and the death was also reported of Mr. John Ferguson, who had been an active member, and contributed a paper some time ago. The papers read to the Association had been very much appreciated. It was hoped that the next session's meetings would be held under more pleasing conditions, so as to allow a forward movement to be carried out.

Appreciation of Contributions to the Proceedings.

The Chairman mentioned that, as a result of Mr. Luck's paper, inquiries had come from the Indiana Gas Company regarding some matters which had been discussed. This showed the far-reaching scope of the Association through the agency of the Press. A paper by Mr. Darling had also aroused interest, especially in the building world. These facts would encourage others to read papers, seeing that their views reached various parts of the world.

Financial Position.—Subscriptions.

The Treasurer's accounts were then submitted, and showed a deficit of £4.

The Chairman explained that the deficit was due to a reduction in the annual subscription, and to twelve complimentary subscriptions being granted to members serving with the forces.

It was agreed to return to the former subscription—namely, 5s. in place of 3s. 6d., *plus* 1s. for a copy of the "Transactions."

The report and accounts were approved.

Office-Bearers for 1916-17.

The election of office-bearers was then proceeded with.

The Chairman explained that it was customary for the Vice-President to become President; but as Mr. Lawrence Farquhar, of Glasgow, last year's Vice-President, was now serving with the forces, he suggested that there should be no change made this year, and that Mr. Farquhar should continue Vice-President.

This was cordially agreed to.

The President (Mr. James J. Scott) and the Hon. Secretary (Mr. Robert Scott) were also re-elected. The following were elected members of Council: Messrs. Luck (Markinch), Duff (Granton), and Gavin (Galashiels). The Auditors were re-appointed.

The Chairman made a suggestion with regard to the conduct of next session. He thought it would tend to increase interest if they held more meetings; and he proposed that there should be eight instead of five, and that some of them should include a visit to certain works. He specially mentioned Thornton Junction and Alloa.

The motion was carried; and it was remitted to the Council to report as to time and places.

Combined Transactions.

The Chairman introduced the question of combining the printed "Transactions" with those of the Western Association in one volume. The question was under consideration of the latter Association, and it was even suggested that they should unite with the English Associations in having one volume.

The suggestion was favourably received, and the subject was remitted to the Council for further information.

CHEMISTRY IN GAS-WORKS.

The Chairman, in introducing Mr. John Baxter, M.A., Higher Grade School and Fife Mining School, Cowdenbeath, to give a lecture on "Chemistry in Gas-Works," with demonstrations, said knowledge of chemistry was absolutely essential in present-day gas manufacture, and one could not go far, even in small gas-works, without chemical knowledge.

Mr. Baxter, after expressing his regret that the demonstration was not to take place in the laboratories of which he has charge, where the necessary apparatus was ready to hand, proceeded to describe some of the estimations required in gas-works. The estimation of sulphur in spent oxide of iron was first dealt with. The necessary apparatus was fitted up, and the various parts and the process explained. After a brief account, illustrated by experiment, of the various operations connected with volumetric analysis, of the preparation of standard solutions, and the use of measuring vessels and indications, the lecturer gave a practical demonstration of the estimation of ammonia in a given sample of ammoniacal liquor. Reference was next made to the composition and analysis

of coal gas, with the aid of the apparatus at hand. The main principles of well-known purity tests for gas in various stages of manufacture were described—such as estimating sulphuretted hydrogen, carbon dioxide, and ammonia in crude gas, and carbon dioxide and ammonia in purified gas. A demonstration illustrating an absorption method of estimating carbon dioxide in purified gas was also performed. The lecturer concluded with a short account of the practice of photometry, the different kinds of photometers, and the method of testing—his remarks being accompanied with a few experiments with a simple photometer and some sketches.

A hearty vote of thanks to the lecturer brought the proceedings to a close.

SOLUBILITY OF NAPHTHALENE IN AMMONIA.

A Cause of the Stoppage of Pipes.

The abstracts from foreign sources contained in a recent issue of the "Journal of the Society of Chemical Industry" included a notice of a paper in the "Zeitschrift für Angewandte Chemie" by Herr S. Hilpert, dealing with the solubility of naphthalene in ammonia as a cause of the stoppage of pipes.

The author pointed out that his determinations of the solubility of naphthalene in solutions of ammonia and in liquefied ammonia gave the following results in grammes per 1000 grammes:

°C.	Ammonia Per Cent.				
	0	5	10	25	100
	Gramme.	Gramme.	Gramme.	Gramme.	Grammes.
0	0·019	0·030	0·042	0·064	33
25	0.030	0·044	0·074	0 162	120

An addition of pyridine increased the solubility of the naphthalene. For example, the presence of 2 per cent. of pyridine in 25 per cent. ammonia solution raised the amounts of dissolved naphthalene to 0·082 gramme at 0° C. and 0·245 gramme at 25° C. Phenol had no influence on solubility. By passing a current of carbon dioxide into a solution of naphthalene in 25 per cent. ammonia, the bulk of the naphthalene was deposited. A 4 per cent. ammonia solution saturated with carbon dioxide and containing 0·5 per cent. of pyridine dissolved about the same amount of naphthalene as did water.

With regard to the condensation of naphthalene in gas-pipes, it is calculated that one kilo. of 25 per cent. ammonia solution will yield 330 litres of ammonia gas at 0° C.; and that this is able to take up 0·015 gramme of naphthalene. Since the same quantity of ammonia solution dissolves 0·16 gramme of naphthalene of 25° C., the bulk of the hydrocarbon must separate on evaporating and cooling the gas.

A technical sample of liquid ammonia contained 0·05 gramme of naphthalene per kilo.; so that a temperature of at least 10° C. would have to be maintained if the naphthalene were to be prevented from condensing in the pipes from the still. This tendency to separation becomes more pronounced with the rise in temperature, owing to the strong increase in the partial pressure of the naphthalene. The vapours from an ammoniacal solution of naphthalene are richer in naphthalene, the higher the temperature of distillation; but the proportion of naphthalene in the mixed distillate is lower than corresponds to the partial pressure of the naphthalene at that temperature.

In general it is advisable to prevent the temperature of the pipes from falling below 30° C., or to interpose a cooling chamber for the separation of the naphthalene. In the presence of pyridine, the temperature of separation is lowered, since the aqueous distillate is able to dissolve more naphthalene.

For the determination of naphthalene, it is said that accurate results are rapidly obtained by the following modification of the picrate method: The naphthalene (not exceeding 0·2 gramme) is dissolved in about 30 c.c. of ether, and the solution added to 50 c.c. of a standard (about $N/20$) solution of picric acid. The flask is closed by a cork, through which passes a glass tube ending in a bent capillary tube. After vigorous shaking for two minutes, the ether is drawn off by suction, *in vacuo*, with constant shaking until the liquid is cold. The flask is then heated on the water-bath to about 30° C., the ether again drawn off *in vacuo*, and so on, until the odour of ether is barely perceptible. It is then allowed to stand for two hours at the ordinary temperature or for ten minutes in ice, the picrate separated with the aid of suction, washed with 5 c.c. of ice water, and titrated with $N/10$ sodium hydroxide solution, with litmus as indicator. For determining naphthalene in ammonia solutions, the sample is chilled in a freezing mixture, and neutralized first with $5N$ and then with $15N$ sulphuric acid. The naphthalene separates in flakes, which must then be separated by distillation with steam, extracted with ether, and converted into picrate as described. Naphthalene picrate shaken with water at 15° C. invariably yielded a 0·067 per cent. solution; and the compound was stable in such a solution. Hence (the author remarks) the currently accepted statement that naphthalene picrate is insoluble only in a saturated solution of picric acid requires modification.

ANALYSIS OF COMMERCIAL BENZOLS.

One of the papers read at the meeting of the London Section of the Society of Chemical Industry on March 6 was on the analysis of commercial benzols, by Messrs. P. E. Spielmann, Ph.D., and E. G. Wheeler, A.I.C., and the text of it appears in the "Journal" of the Society for the 15th inst.

The authors pointed out that this examination of the benzol fraction of light naphtha has become of special interest owing to the Government control which is now being exercised over this branch (among others) of the coal-tar industry. This method of analysis aimed at providing a simple way of determining the percentages of benzene, toluene, paraffin, and carbon bisulphide in a properly washed commercial benzol. There was no new principle involved and no special apparatus was required—negative qualities which might recommend it to industrial laboratories possessing the simplest equipment. The method had been devised in view of the requirements of the Department of Explosives Supplies of the Ministry of Munitions; but it was, in reality, of independent application. It was the outcome of a considerable number of laboratory experiments based on an acquaintance with many hundreds of samples of commercial benzols.

Determination of Toluene.

It has been found that if 100 c.c. of a mixture of benzene and toluene be distilled from an Engler flask at the rate of 7 c.c. a minute, with proper precautions in regard to draughts and efficient condensation of the distillate, the volume in c.c. passing over up to 90° C. indicates the quantity of toluene present in the mixture when reference is made to a previously constructed curve. It has been found, further, that the presence of paraffin and carbon bisulphide in the quantities normally occurring in commercial benzols does not, as a matter of fact, upset this relationship to any material degree.

The method is not to be trusted above 20 per cent. of toluene, because the errors which ordinarily balance one another in any chemical manipulation may, if acting all in one direction, cause an error of 2 per cent. or more. Thus, the increasing inaccuracy with increasing quantities of toluene carries the method into the region of others for the estimation of toluene, which, from this point onwards, show a greater accuracy the higher the percentages of toluene present.

Experience has shown that the estimation of the toluene by the distillation method just described may vary in the hands of different workers with slightly differing apparatus, to the extent of 2 per cent. Although such a discrepancy is in itself undesirable and can be rectified, it does not have any appreciable effect in the subsequent estimation of paraffin.

Determination of Carbon Bisulphide.

The carbon bisulphide is easily and completely removed by alcoholic potash in the known manner; but instead of the potassium xanthate being estimated, the benzol is washed several times with water (in order to remove the xanthate and alcohol) and dried. Its specific gravity is then determined. The difference between the original specific gravity of the sample and the specific gravity just obtained is proportional to the quantity of carbon bisulphide present; and this can be found by reference to a previously constructed curve.

Determination of Paraffin.

After the removal of carbon bisulphide, the liquid consists substantially of a mixture of benzene, toluene, and paraffin. The quantity of toluene has already been determined, and the specific gravity of a mixture of benzene and the ascertained quantity of toluene can be found from a previously constructed curve; so that the difference between the specific gravity of the benzene-toluene mixture and that of the sample after removal of carbon bisulphide is proportional to the quantity of paraffin present, the actual value of which can be found from an experimental curve.

Originally, there was some doubt as to the proper specific gravity to ascribe to the paraffin occurring in benzols. This must certainly vary with the varying quality of coal distilled, as well as with the character of the retorts and the temperature of the destructive distillation employed. From actual analysis, and from theoretical considerations, this has been taken to be 0·730. As a matter of fact, it has been found by experiment that the gravity may vary 0·025 without seriously upsetting the results obtained.

Determination of Benzene.

This constituent is estimated by difference. The work has been based on the specific gravity of benzene being 0·8848 at 15·5° C.—a figure which has been obtained from synthetical benzene, boiling constantly at 80·2° C. To a certain extent the unimportant impurities present in benzol will tend to balance one another with respect to their specific gravities, but with an upward tendency. The most important of these impurities is thiophen. But this is seldom present to an amount of more than 0·5 per cent., and averages about 0·26 per cent. The latter quantity would cause an error of 0·3 per cent. in the quantity of paraffin found; but as this is within the limits of accuracy of the method, it can be neglected.

From the analysis of a number of known mixtures and of

commercial benzols the following can be quoted; results being given in per cent. vol./vol.:

Known Mixtures—Per Cent.

	Benzene.		Toluene.		Paraffin.		Carbon Bisulphide.	
	Taken.	Found.	Taken.	Found.	Taken.	Found.	Taken.	Found.
A.	87·0	87·5	10·0	9·2	2·0	2·3	1·0	1·0
B.	84·0	84·4	10·0	6·8	4·0	4·8	2·0	2·0

Commercial Benzols.

	Distillation Test.		Specific Gravity.		Paraffin. Per Cent.	Carbon Bisulphide. Per Cent.	
	c.c.	Toluene Per Cent.	Original.	After Removing CS_2.		By Curve.	By Titration.
1 . .	98·9	1·5	0·8875	0·8838	0·25	1·05	0·78
2 . .	91·2	11·4	0·8892	0·8840	—	1 45	1·34
3 . .	97·9	3·0	0·8866	0·8839	—	0·75	0·71
4 . .	98·6	2·0	0·8894	0·8857	—	1·00	0·93
5 . .	91·4	7·7	0·8872	0·8810	1·3	1·75	1·70

It will be seen that an average accuracy can be expected to the extent of toluene 1 per cent., paraffin 0·5 per cent., and carbon bisulphide 0·1 per cent.; and that the extreme error is not serious.

A few preliminary experiments with "first runnings" show that this method of analysis can be applied with a slight modification. Taking, for example, No. 3 from the above table:

Distillation: 97·9 c.c. = 3 per cent. toluene
Sp. gr. of original sample = 0·8866
Sp. gr. after removal of CS_2 = 0·8839
Difference 0·0027 = 0·75 per cent. CS_2
Sp gr. of benzene + 3 per cent. toluene = 0·8840
Sp. gr. after removal of CS_2 = 0·8839
Difference 0·0001 = negligible per cent. paraffin

It is interesting to note in passing that the effect of toluene on the specific gravity of benzene is exactly one-tenth of the effect of paraffin of the specific gravity of ·730.

Taking as an example No. 5 from the table:

Distillation: 94·4 c.c. = 7·7 per cent. toluene
Sp. gr. after removal of CS_2 = 0·8810
Junction of 94·4 c.c. ordinate and 0 8810 line is at 1·3 per cent. paraffin.
Sp. gr. of original sample = 0·8872
Sp. gr. after removal of CS_2 = 0 8810
Junction of these two co-ordinates is at 1·75 per cent. CS_2.

At the conclusion of the reading, Dr. Harold G. Colman remarked that he had tested the method described with mixtures of known composition, and had found it to be accurate within the limits given by the authors.

Incandescent Gas-Mantles of Plush.

In a German Patent Journal, the "Ironmonger" reports, Herr Rudolf Langhans proposes to manufacture the fabric of the gas-mantle from plush of suitable texture, instead of from ramie or cotton. The inventor claims that plush can be impregnated and burnt-off in the same way as the fabrics now in use. The incandescent body, in conformity with the texture of plush, would consist of a sieve-like woven basis, containing a very large number of impregnated and calcined glowing-threads—the minute channels running between these threads conducting the gas so that the gas mixture would not reach the texture vertically, as in the ordinary mantles, but parallel with the direction of the threads. The plush mantle is, therefore, of quite different structure from those at present in use; while its capacity of emitting light is considerably greater without prejudice to its durability or its cost of production. The process of combustion in a plush mantle is as follows: The gas mixture, which issues from the close meshes of the basic texture as through a sieve, ignites on the surface of the mantle and burns in the channels which run parallel between the threads; while the flame must be so regulated as to end on a plane with the extreme edges of the threads, which in effect form the incandescent body. As the threads begin to glow, a strong light is emitted at their ends, which decreases towards the interior. The basic fabric prevents back-lighting of the minute flame-particles into the channel. The inventor suggests that mantles made of this texture should be disc-shaped. For this purpose, the burner, which is of ceramic material, is formed like an inverted funnel closed by a kind of sieve. On the burner a disc-shaped mantle is fixed. Cylindrical or semi-spherical mantles can be made of plush, and the burner placed upright.

Enemy Business to be Wound-Up.—No. 111 in the list of orders that have been made by the Board of Trade, under the Trading with the Enemy Amendment Act, 1916, requiring businesses to be wound-up, is the United Chemical Works, Limited, of No. 9, Farringdon Road, London, E.C. (agents for the sale of gas-mantles). The Controller is Mr. C. Bramwell Smith, of No. 79, Bishopsgate, London, E.C.

CORRESPONDENCE.

[We are not responsible for opinions expressed by Correspondents.]

Air Supply to Retort-Furnaces.

Sir,—We have been waiting to see if other readers had any comments to make on the editorial, entitled "In the Interests of Coke Producers," on p. 673 of your issue of March 28—particularly your remarks upon the automatic regulation of the primary-air supply to retort-furnaces—as it opens up a very important question, to which perhaps many of your readers have not given serious attention. It is upon this point that we wish to offer a few criticisms.

Why mention primary air only? The secondary air is subject to similar fluctuations when caused by variation of chimney draught; and it is apparent that fluctuation in draught is mostly due to weather conditions acting on the chimney. Many attempts have been made to control automatically; but, so far as we are aware, they have always taken the form of restricting the area only. This has had the effect of increasing the vacuum which the pull of the chimney tends to cause; and the result is that approximately the same amount of air is drawn at a higher velocity through the smaller opening. A more serious result of this restriction of air inlet, however, is the rapidity with which the gases are pulled through the setting, which not only tends to localize the heat, but causes serious damage to the brickwork and the retorts, by the cutting action of the hot gases which is set up thereby.

The fact that the door of the clinkering frame is open during the operation of clinkering is a point which must not be neglected. No automatic control of the primary-air or secondary-air inlets has any effect in this case; for the air is pulled through the furnace, and a very much larger volume of producer gas than is required is generated, with the result that there is great waste and incidentally overheating.

In our opinion, the proper place at which to apply automatic control is at or near the chimney—*i.e.*, at the outlet from the furnace, instead of at the air inlets—and this was recognized many years ago by different people.

We have seen a model of an automatic chimney draught control designed by Mr. Hudson, of Normanton. The draught in this case was reduced by a butterfly valve in the chimney shaft; but the difficulty in this system was that, while reducing the draught, it also reduced the flue area necessary for the volume of gases.

We have been paying very earnest attention to this matter for some considerable time past; and we are now of the opinion that we have evolved a system for the automatic regulation of chimney draught without throttling the chimney area in any way, and which will keep the draught to a single setting or a whole bench under perfect control.

We would like to refer to a very practical method of overcoming the difficulty of the over-production of producer gases during clinkering which was practised by Mr. H. D. Madden, the Engineer of the Cardiff Gaslight Company, and which was made known to the Wales and Monmouthshire District Institution of Gas Engineers in May, 1911, as reported in your columns at the time. Briefly, the practice is to cover the fire prior to clinkering with a layer of coke breeze, which has the effect of preventing a too-rapid generation of gas during the clinkering operation. It has a third advantage, which at some places may not be the least important one—namely, of getting rid of the breeze in a useful way, besides saving a proportionate amount of saleable coke.

For Drakes Limited,
William A. Drake, Managing-Director.

Halifax, April 20, 1916.

REGISTER OF PATENTS.

Treating Coal and Other Material.

Burrows, L. P., of Ottawa, Canada.

No. 1206; Jan. 25, 1915.

This invention relates to "the treatment of coal and all other solid substances by means of the product obtained by heating water vapour." The invention is based upon the observation that if coal and like solid substances are subjected to the action of the gaseous product obtained by expanding steam, separating any water suspended therein and heating the expanded vapours to a high temperature, decomposition or alteration of the character of the solid material is effected.

Thus, for example, the patentee claims to have found that, by treating bituminous coal in this manner, he obtains magnetic and non-magnetic metalliferous substances and carbonaceous matter as well as hydrocarbons. The hydrocarbons so obtained comprise a material which may be used as paint, illuminating oil, and a distillate of low boiling point similar to gasolene or petrol. "In addition, a gaseous product is obtained free from carbon monoxide and carbon dioxide, and the volume of gas obtained from a given weight of coal is found to be much greater than can be obtained by other processes."

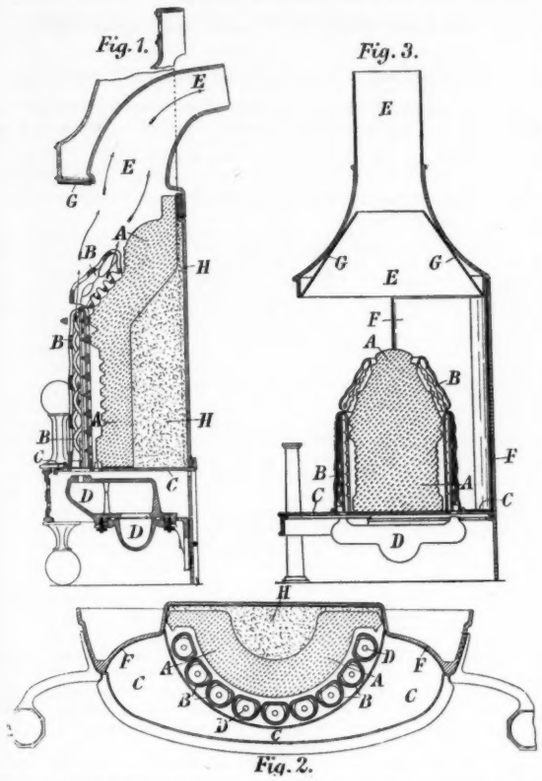
Gas-Fires.

Richmond Gas Stove and Meter Company, Limited, and Hartley, H., of Warrington.

No. 4770; March 27, 1915.

This invention refers to gas-fires in which the gas burned heats a refractory "fuel" so disposed that the "heat is radiated sideways in planes parallel with the general plane of the fire as well as directly forward into the room or space in which the gas-fire is placed." It is claimed that this arrangement provides a gas-fire "by which the effi-

ciency of the heating effect, for a given consumption or quantity of gas consumed, and the distribution of radiated heat are improved."



Hartley's (Richmond Gas-Stove Company) Circular-Fronted Gas-Fire.

In the arrangement shown in figs. 1 and 2, the fuel B and body A project outwards from the back part of the fire in about the form of a semi-circle, and protrude from the back surface therefore at the sides of the heat-radiating part to the extent determined by this formation. The reflectors F project out at each side of the fuel at the base of the body in a forwardly curved manner. The exposed upper surface of the base-plate C also constitutes a heat-reflecting surface; and a heat reflector G may also be provided within the base or entrance of the hood E, as shown in figs. 1 and 3.

The protruding body and the fuel in the case shown in figs. 1 and 2 are substantially parallel or vertical from the lower portion upwards to a certain level; and above this recede backwards at an angle towards the normal base or back surface of the heat-resisting body. Thus the formation of the upper part is conical. But in some cases, these upper parts of the fuel lying over and on the backwardly tapered part of the body may be dispensed with.

The body in figs. 1 and 2 may have a cavity at its back; and this cavity, and the space between the body and the back-plate (in the case shown it is one with the reflectors), may be filled in with slag wool H, or other bad conductor of heat.

In the modification shown in fig. 3, the heating body A is cylindrical; the fuel elements B are arranged all round it; and the flame nostrils of the burner D are disposed under the lower ends of the fuel all round. Extending out at each side of, and behind, the body, is the reflector F. The fuel protrudes outwards beyond the edges of the back and reflectors, so that it "can radiate heat horizontally into the room in which the fire is placed, sideways in planes parallel with the general plane of the fire, as well as directly forward, and at intermediate angles."

Gas-Lamps.

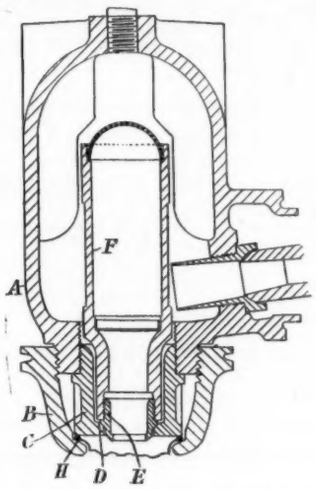
KEITH, J. & G., of Farringdon Avenue, E.C.

No. 4841; March 29, 1915.

This invention relates more particularly to inverted incandescen gas-lamps for high-pressure gas lighting.

In their patent No. 14,489 of 1913 the inventors described a burner comprising a structure serving as a preheater for gas and air directly connected to which structure is a metallic nozzle shielded by a cup-shaped mantle-support. The present invention, while retaining advantages incidental to this construction, offers, *inter alia*, the additional advantages that "it renders practicable the use of a nozzle tip composed of material capable of withstanding very high temperatures, entails reduction of the area of metal exposed to the flame and therefore of the emanation of metallic particles, and confers greater assurance against tendency of the flame to light-back."

As shown, the body A of the preheater is fitted with a mantle-support B, as described in the earlier patent. As in the case of the construction then described, the preheater serves for heating the gas and air mixture; but in the present invention it is immaterial whether the mixture or air alone or gas alone be passed through the preheater." Engaging an internally threaded orifice in the lower end of the preheater body is a bush C—of refractory material, having near its lower end an internal annular shoulder presenting a seat D—its lower external edge being above, and close to, the bottom of the mantle-ring receiving recess formed in the support B. The nozzle proper or burner tip E (of metal capable of withstanding very high temperatures) is formed with a tapered shoulder bearing on the seat, and is in screw-threaded connection with the lower end of a metal tube F, which extends upwardly



Keith's High-Pressure Inverted Gas-Lamp.

into the interior of the heater. The engagement of the tapered shoulder on the tip with the shoulder on the bush is sufficiently close to prevent any passage of the mixture of gas and air contained within the preheater; but the tip is freely separable from the bush C, on the shoulder of which it rests.

The tip E being shielded by the bush (which is a poor conductor), the area of its exposed portion is relatively small, so that the nozzle does not collect heat from the flame as rapidly as heretofore. It is thus possible to select for the composition of the nozzle proper a metal capable of withstanding very high temperatures; the selection being no longer limited to the choice of a metal of good thermal conductivity. The reduction in conductivity is compensated for by the comparative shortness of the path along which the heat travels before it reaches the tube.

A feature of considerable practical utility is said to be that the bush can be readily unscrewed, even after the lamp has been heated for a long time; whereas, heretofore, difficulty was sometimes experienced in unscrewing the metal nozzle after it had been in use.

The lower end of the bush enters the mantle-ring receiving recess, so that, when the mantle support is screwed-up, the mantle ring H is lightly held between the support B and the bush C, whereby the mantle is steadied, and the space between the bush C and the mantle-support B is cut off from communication with the flame—the upper portion of the bush being thus screened from excessive heat.

Coin-Freed Meters.

AUTOMETROGRAPH AKTIENGESELLSCHAFT, of Budapest, Hungary.

No. 5193; April 6, 1915. Convention date, April 24, 1914.

This invention relates to coin-freed meters in which the action of removing the money from the machine brings about the operation of mechanism whereby a printed record is made of the money taken and the recording mechanism is at the same time "zeroized."

In machines of this class the arrangement is usually such that the total number of coins taken by the machine is recorded at the moment of removing the coin receptacle, even if the consumption corresponding to the coins has not, in fact, taken place. The object of the present invention is to provide a receptacle accessible to the controlling attendant which contains always only the amount of money (irrespective of the total sum taken by the machine) which corresponds to the actual consumption.

To this end the feed of coins from the receiving receptacle which is connected to the collecting receptacle is controlled by mechanism operated by the meter according to the extent of the consumption, and the collecting receptacle is connected to a recording counting train adapted to print a receipt and indicate the number only of the coins contained in the collecting receptacle—that is to say, the amount in money corresponding to the actual consumption at the time being—and likewise so that the collecting receptacle can be detached only after the insertion of a printing frame which cannot be withdrawn until a receipt has been printed and the recording counting train has been reset to zero.

Machines for the Manufacture of Incandescent Mantles.

BARK, B., and PURLE, H. W., of Broomhill Road, Wandsworth.

No. 9558; June 30, 1915.

This invention relates to a machine in which an anvil or pleating member, consisting of teeth or wires, is employed, upon which the tubular mantle fabric is placed and corrugated or pleated by the advance of a pair of toothed jaws co-acting with the anvil or pleating member—a "shirring thread" being drawn through the pleats or corrugations by means of needles. The invention is primarily intended

for use in the manufacture of incandescent mantles, although it is applicable to other tubular articles of suitable material.

In the manufacture of incandescent mantles upon machines of the character referred to, it was found in practice, the patentees remark, that the tubular fabric was more or less inelastic and, consequently, was liable to be torn or strained when pressed between the teeth of the jaws and the pleating member by reason of the rigidity of the teeth, so that only certain kinds of material could be used with advantage. The object of the present invention therefore is "by a simple contrivance" to remedy the difficulty.

Producer-Gas Plants.

CROSSLEY, K. I., and FIELDEN, F., of Manchester.

No. 14,830; Oct. 20, 1915.

This invention in producer-gas plants is particularly applicable to suction-gas plants.

The patentees point out that in such producer-gas plants it has hitherto been customary to place the open mouth of the gas outlet pipe in the lid of the vertical generator immediately above the fuel bed, so that the gas generated flows directly upwards and straight into the open mouth of the outlet pipe. The chief defect of this arrangement is said to be that tarry deposits and small particles of unconsumed fuel are drawn by suction from the fuel bed and cause gradual choking-up and clogging of the outlet pipe. Their invention therefore consists essentially in a construction of gas outlet pipe having its open mouth pointing directly upwards and provided with scrapers worked at any time for cleaning purposes in straight lines along the pipe and its branches without interfering with the working of the plant.

PARLIAMENTARY INTELLIGENCE.

HOUSE OF LORDS.

The following further progress has been made with Bills:

Bill brought from the Commons, read the first time, and referred to the Examiners: South Metropolitan Gas.

Bills read a second time and committed: Plymouth and Stonehouse Gas, Uxbridge Gas.

HOUSE OF COMMONS.

The following further progress has been made with Bills:

Bill read a second time and passed: Imperial Continental Gas.

Bill read the third time and passed: South Metropolitan Gas.

The Aberdeen Corporation Water Order Confirmation Bill has received the Royal Assent.

Coal Shortage.

On Monday of last week, Mr. NEVILLE asked the President of the Board of Trade whether he was aware that many public utility companies find it impossible to buy their requirements of coal for the coming twelve months; and whether, under these circumstances, power could be given to the local Coal Committees, which have been recently established in the colliery districts, to requisition coal?

Mr. RUNCIMAN replied that a number of cases in which public utility undertakings had experienced difficulty in obtaining contracts for the full supplies of coal which they require had been referred by the Board of Trade to the district Coal and Coke Supplies Committees, and they had in some of these already been able to make suitable arrangements. He hoped it would be found that supplies of coal to these undertakings could be maintained without requisitioning.

Daylight Saving.

Mr. PETO asked the Home Secretary whether he had any official information showing that the German Federal Council had adopted a Daylight Saving Bill to be enforced in Germany during the summer months; whether he had any information of the intention of the Government of the French Republic to enforce a similar measure; and whether His Majesty's Government intended to take a similar step in the interest of national economy and the comfort and efficiency of the working classes?

Mr. SAMUEL said that he had observed statements in the Press to the effect that Germany and Austria were about to adopt a measure similar to that embodied in the Daylight Saving Bill, but he had no official information. He was making inquiry with respect to France and other countries. The question was receiving the attention of the Government.

Belfast Water-Works Extension.—The Law Committee of the Belfast Water Commissioners have reported that the Arbitrator appointed by the Board of Public Works, Ireland, to assess compensation to be paid in respect of lands and rights to be acquired under the Belfast Water Act, 1912, has issued his draft award, amounting to £7668. This is an increase of £1367 on the sums offered by the Commissioners in the schedule lodged by them.

Coal Famine in Denmark.—The scarcity of coal in Denmark, says the Copenhagen correspondent of "The Times," is growing; and a committee of provincial towns and gas companies has asked the Home Office to help in getting supplies at reasonable prices immediately from England. Some factories in Bornholm, which are already using coal from the local coalfields, made an investigation in order to ascertain whether it would be possible to work these sources of supply on a more extensive scale.

MISCELLANEOUS NEWS.

CO-PARTNERSHIP IN THE GAS INDUSTRY.

Annual Meeting of the Labour Co-Partnership Association.

An informal gathering (owing to the war conditions) was the annual meeting of the Labour Co-Partnership Association, which took place last Wednesday, in the Central Hall, Westminster, with Mr. H. Daniels in the chair. Earl Grey is the President of the Association; and it was unanimously decided to ask him to again act in this capacity during the ensuing year.

The report which was adopted stated that the chief industry in which co-partnership has been widely adopted in the gas industry carried on by public companies. Of such companies, 43 have adopted profit-sharing; and of these 43, four have amalgamated with some other profit-sharing company, and one only has brought its scheme to an end. This was done after a trial too short to be of any value as a criterion of success or failure. Thus there are now 38 companies. Three of these —Shrewsbury, Maidenhead, and Eastbourne—were new in 1915. There was included in the report the subjoined table, and particulars of three new schemes—one of which is in connection with the borough of Burton-on-Trent. There are thus two municipal schemes now in operation, that of the Stafford Corporation Gas and Electricity Department dating from 1900. It may be remarked that at Stafford for 1915 a dividend of £989 (or about 11 per cent.) was allotted among the 151 employees of the gas department, and £173 (or 15 per cent.) among the 15 employees in the electricity department. At one time the Association embraced in their list the schemes of the Bridgwater Gas Company and the Newport (Mon.) Gas Company, which, however, they say do not comply with the usual definition of profit-sharing. Under the scheme at Bridgwater, a dividend on labour is paid—the rate depending, not on profit, but on economy of production. For 1915, a dividend of 10 per cent. (2 per cent, higher than for 1914) was paid on the wages of 26 employees. The employees received £196, and now have £760 invested in the capital of the Company. The Newport Gas Company have had a fixed bonus scheme in operation for fifteen years, and have also given facilities to the workers to invest their bonuses and other savings in the capital of the Company. For 1915, a sum of £513 was distributed among 135 employees, who have altogether received £9346, and have £6226 invested under the scheme.

On the general question, the report proceeded to point out that gas companies have suffered from the effects of the war; and many have had to increase the price of gas, the consequences of which are reduced dividends and smaller bonuses to employees. Seventeen of the companies have only been able to pay reduced dividends on wages, fourteen the same dividend as last year, while in three cases the dividend has risen. On the whole, the dividend is £29,638 less than for 1914, having fallen from £146,686 to £117,048. In 1913, the number of co-partnership companies was 33, and the capital of the workers £837,531; while in 1915, with 38 companies, the capital was £842,284. The smallness of the increase shown by the last figure over the 1913 one, the Secretary (Mr. E. W. Mundy) pointed out, is due to the fall in the market price of stock. It is gratifying to see it stated in the report that co-partnership has so well stood the test of the existing unfavourable conditions. "There is," we are told, "no evidence of any trouble with co-partner employees arising from the decrease in bonus—or, indeed, from any of the conditions brought about by the war. It has frequently been said that workmen will not share losses; but many thousands of gas workers are now doing so uncomplainingly, though the loss is one which comes from conditions which neither sliding-scale nor co-partnership scheme could have contemplated. Another argument of co-partnerhip's opponents has been splendidly refuted—the argument that a man's outlook and sense of duty are narrowed by his interests being identified with those of his employer. From co-partnership gas companies a great stream of patriotic volunteers have gone to ship, and trench, and hospital—the South Metropolitan Company alone contributing about 2000 men, or 30 per cent. of their employees, before the Derby scheme came into operation or compulsion was seriously threatened."

Attention is drawn to the scheme of the Consolidated Gas Company of Boston (U.S.A.), whose ninth distribution of profits was that for the year ended June last. The dividend on wages was at the rate of 8½ per cent.; some 656 workers sharing £10,805. The workers have so far received altogether £84,163, and hold £67,488 in share capital; while one of their number is on the Board of Directors. That both shareholders and consumers have benefited from the scheme, is shown by the fact that the increased profits divided among the shareholders since the introduction of the scheme amount to £136,120, and the value of reductions in the price of gas is £787,800.

Co-Partnership after the War.

The formal business of the meeting at an end, Mr. F. Maddison, J.P., in a rousing speech, opened a discussion on the subject of "Co-Partnership after the War." In the course of his remarks, he declared that at present, in spite of the apparent state of prosperity, we were practically living on capital. Therefore, from an economic point of view, appearances were deceptive. And what was going on now must be paid for, roughly and really, by people who worked. The huge taxes to pay off the loans would have to be met by industry; they would have to be paid by the producers. When the war was over, the country would be confronted by very serious difficulties of various kinds. For instance, there had been an extensive suspension of trade union rules and conditions during the war; and this suspension had been loyally accepted by the great mass of the trade unionists. They accepted it from patriotic motives. But this suspension of the trade union rules meant their restoration; and the restoration would bring into being good and healthy rules, and also bad and unhealthy ones. After the war—though perhaps not immediately—there would be a good deal of unemployment, accompanied by falling wages; and there would be discontent with industrial conditions. It was mainly upon

British industry that would rest the task of restoring the gaps made in the country's finances, and all the rest of it; and the first thing needed was efficiency all through. They wanted efficiency of the employer, efficiency of the workmen, and efficiency everywhere. They required in industry the spirit of the volunteer, and not the conscript. The appeal of the Association was to the highest-minded employer—the man who was touched by the real dignity of craftsmanship, and believed he was a trustee bearing a very great responsibility. This belief was held by a far greater number of employers than they had any idea of. Then the Association appealed to the correspondingly high-minded men among the workers. They desired, in the first place, closer contact between the employer and his men. Many capitalists must face more modest profits in the future; and, on the other hand, the trade unionists must not be content with merely forcing-up wages by might. He believed himself that the time had arrived when co-partnership had had sufficient trial, and had sufficiently justified itself, to make it very desirable that there should be an authoritative inquiry into the whole question of industrial relations. It would be an immensely good thing if (say) a dozen employers and employed, with one or two professors of political economy, would quietly think out this problem, and state whether they thought there was anything in this co-partnership movement big enough to apply to national industry on the large scale. The Association knew it could do great things on a limited scale; but they wanted an opinion as to whether it was capable of being indefinitely extended.

The following table and particulars of new schemes were included in the annual report.

Particulars of Co-Partnership and Profit Sharing in British Gas Companies at Dec. 31, 1915.

Name of Company.	No. of Years Scheme has been in Operation.	Capital in 1915. Total Share and Loan.	No. of Employees under Agreement for Profit-Sharing or Co-Partnership.	Amount Divided Among Employees for Year ending December, 1915.	Amount per Cent. on Wages.	Total Profit to Employees since Scheme was Adopted.	Amount of Shares and Deposits held by Employees in the Company. Market Value on Dec. 31, 1915 (about).
		£		£		£	£
S. Metropolitan (*a*)	26	8,505,340	6,260	36,760	6	728,356	382,735§
South Suburban (*a*)	22	1,386,705	1,011	5,017	5⅜	61,485	50,164
Commercial . .	14½	2,548,280	1,264	6,157*	5½	79,238	64,143
Chester	14	181,414	93	546*	6½	4,651	2,658
Leamington Priors	8	86,500	108	421	5	3,079	3,038
Wrexham . . .	8	141,560	70	343	7	2,760	2,323
Rugby	8	64,254	45	199	5¼	1,820	..
Tunbridge Wells .	8	178,266	137	649*	6	4,685	3,562
Bournemouth . .	7	832,748	481	3,048	7	18,314	19,359
Cardiff	6½	703,014	339	1,982	5½	8,487	7,756
Gloucester . . .	7	238,762	114	613	7½	3,902	2,822
Walker & Wallsend	7½	266,668	95	457*	4½	2,855	5,866
Wellingborough .	7	90,853	64	353*	6	2,180	1,563‖
Tottenham, &c. .	7½	1,948,705	700	5,891*	9	31,424	25,136
Croydon. . . .	7	773,767	646	3,113†	5½	15,526	20,984
Weston-super-Mare	7	167,218	129	280	3	1,945	1,481
Gas Light and Coke	7	29,483,228	9,452	29,953	3¼	258,470	174,977
Grantham . . .	6	106,068	53	211†	6	1,343	930°
Cambridge . . .	6½	200,824	182	989*	6¾	5,254	3,880
Waterford . . .	6½	70,900	62	277*	8	1,628	1,151
Ilford	6	280,505	177	921	5¼	4,409	4,525
Watford . . .	5½	217,677	110	453	4¼	3,196	4,070
Dartford . . .	7	117,346	40	50	4	1,265	984
Longwood . . .	5	100,244	40	126†	4	942	450
Wandsworth . .	5½	1,263,253	849	5,122	6¼	19,007	13,696
Merthyr Tydfil. .	5	81,253	33	115	4¼	520	375
Plymouth . . .	5	409,017	334	835†	3	4,550	4,150
Liverpool . . .	4½	2,985,124	1,817	8,711	5¼	34,106	35,156
Harrow	4	333,956	108	382	4¾	1,687	991
Hertford . . .	3	22,609	18	89	6	289	135
Aldershot . . .	4	430,387	173	596	4½	1,858	975
Canterbury . . .	3	158,884	79	245	4¼	771	135
Swansea . . .	3½	441,515	185	672*	4	1,988	106
Redhill	2½	133,150	70	249*	4	425	20
Ipswich	1½	193,783	210	821*	5	1,622	1,439‡
Shrewsbury. . .	2½	166,903	117	289*	3¾	682	339
Maidenhead . .	1½	107,300	40	113*	4	113	159
Eastbourne . .	..	..	..	..	..	..	..
Total for 38 companies	—	55,477,981	25,705	117,048	..	1,314,832	842,284

(*a*) Three employee representatives on the Board. § Upwards of £40,000 stock belonging to pensioned employees and widows of co-partners has been transferred to the ordinary Share Ledger, and is not included in this figure. * Year ending June. † Year ending March. ° Including presentation stock £139 at commencement to old employees. ‡ Commenced with the gift of a year's dividend. ‖ Excluding capital purchased outside the scheme.

Maidenhead Gas Company.—The scheme was started for the year ending June, 1915. This Company have a sliding-scale for price of gas and rate of interest, and have now arranged to pay a dividend on wages at the rate of ½ per cent. for every 1d. below 4s. that they are able to sell gas. Half the dividend is retained by trustees for the purchase of shares, and the other half is withdrawable by the co-partners. Opportunity is given to the co-partners to leave the withdrawable part of their dividend on deposit with the Company, and to add to this their savings as well, if they so desire.

Shrewsbury Gas Company.—The scheme was started for the year ending June, 1914. The standard price of gas taken as the starting point is 3s. 4d. per 1000 cubic feet. At any higher price, there is no dividend on wages. At 3s. 4d. the dividend is 1 per cent.; and for every fall of 1d. in the price of gas the dividend rises ½ per cent. So that when gas is at 3s., the dividend is 3 per cent.; when gas is at 2s. 6d., the dividend rises to 6 per cent.: and so on. Half the dividend is retained by trustees, and is invested by them in the Company's ordinary stock when the sum becomes large enough—receiving meanwhile interest at 4 per cent. The other half is withdrawable, but receives interest at 4 per cent. The Company state that they desire that the withdrawable half shall be left at interest, and that they will not consider the scheme successful unless most of it is so left.

Borough of Burton-on-Trent.—The Corporation adopted a scheme in 1914, and the first dividend was distributed in March, 1915. The 215 employees in the gas department received a dividend of 2½ per cent. on wages, and those in the electricity department received a dividend of 6½ per cent. The engineers of both departments speak well of the success of the scheme so far, both from the point of view of the management and also of the workers. In the gas department, when the total net expenditure for manufacturing (less the receipts from residuals), distribution, and all other charges, exclusive of interest and repayment of loans, is in any year less than 2s. per 1000 cubic feet of gas sold, then the employees of the gas department are entitled to a bonus on the salaries, wages, sick pay, or accident pay received by them, calculated at the rate of ½ per cent. for every 1d. or fraction of 1d. below this 2s. In the electrical department, the rate of dividend on wages is calculated as twenty times the amount by which the total cost of the electricity is less than 1d. per unit sold. Thus, for the year ending March, 1915, the cost was 0·686d. per unit. Twenty times the difference between this and 1d. gives 6·28; so that the dividend was 6·28 per cent. on wages.

PRIMITIVA GAS COMPANY OF BUENOS AYRES, LIMITED.

Gloomy Difficulties.

The Annual General Meeting of the Company was held last Tuesday, at River Plate House, Finsbury Circus, E.C.—Mr. A. E. Bowen in the chair.

The Secretary (Mr. J. M. Macmorran) read the notice convening the meeting; and the report of the Directors and the statement of accounts were taken as read.

PRIVATE CONSUMERS' ECONOMIES.

The Chairman, in moving the adoption of the report and accounts, referred with the deepest regret to the death, last February, of one of the Directors, Mr. J. Murray Tulloch. Mr. Tulloch's business capacity and his long experience of the Argentine were of the greatest service to the Company, and at the Board he was missed very much. Turning to the report and accounts, the Chairman said, when the Directors met the shareholders last year, he had a bad tale to tell; and, though by the strenuous efforts of everyone here and in Buenos Ayres, they had succeeded in further reducing administration expenses by £20,700, the net result was very much worse for the year under review. The financial conditions prevailing in 1914 continued throughout last year; and, as far as the business was concerned, there had been no improvement. On the contrary, the sales of gas to private consumers had fallen off steadily all through the year. In 1913, the sales of gas to private people totalled £677,198; in 1914, £582,701; and in 1915, only £502,690. This explained a good deal of their trouble, but not all. The continued stagnation in trade and want of money caused their customers to further economize; and it was found on analysis that, on 251,877 accounts issued monthly for private lighting, there was an average decrease of $0·73 per account; and on 403,127 accounts for heating and power, the average decrease had amounted to $0·61 per account per month. These two items alone had affected the Company adversely to the extent of £37,535. House coal was almost unobtainable in Buenos Ayres at present; and he was afraid that they might have a much increased demand made upon them for gas for heating and cooking purposes, on which they could not make any profit with coals and freight at present prices. During the year they had to cut-off supplies of gas from 6373 consumers for non-payment. Principally owing to this drastic measure, they had a decrease in bad debts of £5660, as compared with the previous year; and the percentage of bad debts was only 2·04 of the accounts sent out. This was the lowest they had had for a good many years.

COAL PRICE—CONTRACTS CANCELLED—FREIGHTS.

The net increase in the cost of coal was £62,984—say, 9s. 6d. per ton on the 132,599 tons they carbonized. The shareholders would better understand what this meant when he told them that in 1914 the gas coal delivered into the works cost what was then thought to be the high price of 32s. 6d. per ton, whereas in 1915 the cost was 42s. per ton. Moreover, it was only with the greatest difficulty that they maintained the supply of coal, because the British Government prohibited, almost entirely, the export of South Yorkshire gas coals for which the Company had contracted to the extent of their requirements over most of the year. These contracts had to be cancelled at a loss to the Company of many thousands of pounds. The Directors were, consequently, obliged to fall back on American and Durham coals, neither of which gave nearly the same results in the Company's retorts as South Yorkshire; and the prices they had to pay for the substituted coals were very much higher than the contract figures. But even this was not the worst result. The Directors effected several reasonable charters of steamers for which they were refused permits; and, in several instances, steamers were commandeered by the Government, and these had to be replaced at an extra cost of hundreds of pounds. One of the comparatively cheap boats was torpedoed on her way to her loading berth.

NO HELP FROM THE MUNICIPALITY—PUBLIC LIGHTING DEBTS.

These were the principal troubles they had had to face, though, in addition, all the stores and materials for the works had advanced in price considerably—in some instances, 200 to 300 per cent. Every day since he last met the shareholders, these conditions had been on the Directors' nerves; and they had been endeavouring by every possible means to obtain some consideration from the Municipal Authorities in Buenos Ayres. They had hopes, from time to time, of being permitted to charge a meter-rental, or even to be allowed a temporary increase in the price

of gas; but, notwithstanding everything they had been able to do, and all the hard work put in by the Local Committee and Manager, they had been unable to get any help whatever. Worse than this, the Municipality had been in grave financial difficulties—at least, the Board imagined so, because they had not been able to pay the Company for the public lighting for more than a year, with the consequence that they had been pressed for money; and it was quite evident they could not go on with the public lighting unless they were paid a large amount of cash. In order to get something tangible in hand, on which they could, if necessary, raise money, the Board, after long negotiation, obtained six-months' Treasury Bills for about £100,000. But, unfortunately, these bills were not met at maturity; and they were now in treaty with the authorities as to their renewal. In addition to this £100,000, they had owing to them by the Municipality a further sum of £28,984 to the end of the year for public lighting; and up to date further sums had accrued. He did not wish in any way to minimize to the shareholders the very grave situation in which this treatment by the Municipality had placed the Company. The Municipality had broken their contract by not paying the Company; and the least sense of justice should have induced them to help the Company to tide over these bad times by permitting some laxity in the prices the concession allowed them to charge. They were, of course, negotiating with the authorities still; and he sincerely hoped that some sort of *modus vivendi* would be arrived at, so that it would not become necessary to cut off the supply of gas for public lighting. The Board very fully recognized the fact that this was a public utility concern; that it was their business to remain on good terms with the authorities; and that they should do everything in their power to help the great city in which the Company had what was practically a gas monopoly. But what could the Company do if they had no money to pay for coals and freights, both of which were unobtainable except for cash? He had just received a cablegram from the Local Committee, which stated that they had been unable to obtain payment from the Municipality; and so they had asked for arbitration. What this meant he did not know, as he could not see there was anything upon which to arbitrate. They had been obliged to pay the tax of 10 per cent. (according to the concession) on the gas sold, although the Municipality had not paid them for the public lighting. The shareholders were not likely to give the Directors any more capital even if they could see their way to ask for it, and the British Government would allow them to subscribe; and, of course, there was a strict limit to what they could borrow from their bankers.

PRESENT COAL POSITION.

It might perhaps be thought that he had painted the picture in sombre colours; but he assured the shareholders this was not the case. Far from it. The accounts as now presented were made up on the basis of coal costing, put into the works, 42s. per ton; whereas, to-day freight alone to Buenos Ayres was about 65s., and 77s. 6d. had been paid by several people, though not so far by the Company. Coal which, on an average, cost the Company last year, f.o.b. English port, 15s. 1d. per ton, was to-day 26s. when obtainable, which was seldom. It would, therefore, be seen that, unless the Company were afforded some relief by the Municipality, and allowed to charge even a small part of the extra cost of gas, they would be in a very much worse position next year than now. From what he had said, the shareholders would observe that he was adhering to his invariable rule of telling them all he knew himself about the situation. That this practical monopoly of the gas industry in one of the largest and richest cities in the world must eventually be a good business, he had not the slightest doubt; and he still had some hope that the Municipal Authorities would consent to render some assistance at this crisis of the Company's fortunes. He had been in the gas business since 1880; and this was really the first set-back he had seen in all the time.

LOCAL COAL, BUT NOT YET AVAILABLE.

Their Manager (Mr. Angus), in desperation at the cost of his coal, made a long and very trying visit early last December to Neuquen, in the south of the Republic, as it was common knowledge in the Argentine that considerable deposits of very excellent coal had been discovered there. He (the Chairman) was glad to say Mr. Angus got back safely to Buenos Ayres in good health, but with the loss of a good many pounds avoirdupois. He sent the Directors a most interesting report of his journey, as well as samples of the coal he found. It was a good gas coal, which, in the experimental retorts, had given excellent results, both in regard to yield of gas and coke; but it remained to be seen whether its position, some 1100 miles distant from Buenos Ayres, and (say) 300 miles from railhead, brought it within the region of practical politics. It would, of course, be a godsend to the Company, and to the Republic in general, if it were found to be of commercial utility. He was sure their thanks were due to their friend, Mr. Angus, for this great effort—made at very considerable personal discomfort and risk—to solve their difficulties.

OIL, COKE, AND WOOD IN GAS MANUFACTURE.

Meantime, they had succeeded in obtaining considerable quantities of gas oil at what, under present circumstances, were reasonable prices; and quite a large percentage of water gas was now being made. This had its drawbacks, of course, in that it used up a large proportion of their make of coke, which fuel now commanded absurdly high prices in Buenos Ayres, owing to the shortage—he might say, the almost complete absence—of imported house coal. To show that their Manager had not left a single stone unturned, he might tell the shareholders that they had lately made considerable purchases of Red Quebracho hardwood, from which they were now making gas, and so eking-out the coal stocks.

IF NO RELIEF, GAS MAKING MUST BE STOPPED.

To sum up the position, he thought he had made it clear that the immediate future of the business depended entirely upon the treatment received from the Municipal Authorities. If they would not render any assistance in the way of allowing a charge for meter-rental, or permitting an increase in the price of gas temporarily, and, above all, if they did not succeed in paying the greater part of what they owed the Company, it would be quite impossible to continue the business. They would be compelled to stop gas making, and accept the consequences whatever they might be.

ITEMS FROM THE ACCOUNTS.

Continuing, the Chairman reviewed the accounts. Among the points, he mentioned that the additions to capital were only £17,531, as against £60,738—a reduction of £43,206, compared with the previous year. Capital expenditure had been reduced to a minimum; but, as the shareholders were aware, the Company could not entirely avoid extensions of mains. Stocks of coal, oil, &c., were £505,501, as compared with £510,715 in the previous year. This was much the same thing in value; but, owing to prices, it did not represent the same thing in volume. It had not been possible to make any provision in the accounts for the Retiro Works amortization. This was very unfortunate; but it would be understood that there was no help for it. The bills receivable, £215,778, compared with £135,000 last year; the increase being mainly due to their having received from the Municipality of Buenos Ayres the treasury bills to which he had already referred against arrears of lighting account, *plus* interest, for no less a sum than £99,279. Referring to profit and loss account, the revenue was £171,282, against £255,809—a falling off of £84,526. Interest on the purchase price of the electric section was £20,468, as against £20,769 last year. Interest on investments amounted to £1044, as against £1377 the previous year. Debenture interest was £65,784, as compared with £66,459. Income-tax remaining to be borne by the profits after taking credit for debenture interest deducted from the holders, amounted to £26,122, as against £12,516 in 1914, and £6228 in 1913—an increase of more than double the amount of 1914, and considerably more than four times the amount of 1913. The sum carried to appropriation account was only £85,517, against £179,326 last year—a falling-off of no less than £93,808. The Directors had been obliged to transfer from general reserve £18,511 in order to provide for the preference dividend paid on Jan. 1 last. In conclusion, he alluded to the anxious work of the General Manager and the Local Committee in Buenos Ayres. They had succeeded not only in reducing expenses; but in carrying out the instructions of the Board to confine expenditure to the barest needs of the business.

Mr. H. E. Jones, in seconding the motion, said he should like to say that, if the shareholders knew the anxieties and labours that had attached to the conduct of the undertaking during the past year, they would be surprised that the Directors had got so far as they had done. These labours and anxieties fell chiefly upon their working Chairman, whose zealous, energetic, and able spirit in the administration of the Company's affairs commanded the admiration of all his colleagues; and he must have borne, and did bear now, a very serious burden and responsibility. The Municipality, of course, were not exactly "playing the game" with the Company in this matter. They had no ill-will towards the Company; and their position, he gathered, was one of extreme difficulty and trouble. Probably they could not find money; but they might at least find sufficient business acumen to sympathize with the Company's position. Some French towns, within his own experience, where gas was supplied under concession, had allowed an increase in the price of gas during the pressure of the war. He also asked the shareholders to remember that Buenos Ayres was a magnificent city. Though it was under a cloud now, partly owing to the war and partly to financial difficulties, there was an enormous future for any of the companies carrying out large public services to such a population.

After a few comments from shareholders—sympathetic and not critical—the motion was unanimously carried.

Proposed by the Chairman, and seconded by Mr. Ross Pinsent, Mr. F. C. im Thurn was re-elected a Director.

The Chairman next proposed the re-election of Mr. J. D. Pearson as a Director.

More as to Argentina Coal.

Mr. C. P. Ogilvie, in seconding, referred to the coal in Argentina. He said the coal itself was distinctly good for gas making. But the curious part of it was that it was up-on-end; and it required a great deal of careful survey work to find out where it finally came to its level. The coal at the outcrop was perpendicular; and how far they would have to go down was the question. Geologically, it was quite an unknown district; and it was not within knowledge where the strata levelled out. Until this was found, and communication was made with the spot, he could not look upon the coal as being of any value to Buenos Ayres, as it could not be obtained cheaply in large quantities. One other point. There was at present little in the way of imports going into Argentina; but there was an extraordinary amount of value going out in the way of exports. This must finally reflect itself in advantage to the City of Buenos Ayres.

The Auditors (Messrs. George Touche and Co.) were re-elected.

The Chairman proposed a vote of thanks to the staffs in Buenos Ayres and London. As the shareholders might easily imagine from what he had said, they had had an exceptionally trying and worrying year. The London Office had been worried almost to death with the trouble of obtaining coals and materials. He attended the office every day, and knew how hard the work had been. Mr. Angus, their Manager in Buenos Ayres, had done everything that mortal man could do to come to a settlement with the Municipal Authorities. He had also made wonderful reductions in the costs of the administration of the Company, which were already very low; and he had been ably backed up by the Accountant and his staff.

Mr. H. E. Jones seconded the motion, which was heartily agreed to.

Mr. A. T. Eastman said just as they were full of loyalty to the country, so must they be in these hard times to the Directors; and he thought they ought to express their thanks more than usual for their work this year. [Hear, hear.] He moved that a very hearty vote of thanks be passed to the Chairman and Directors.

Mr. C. J. Hollis seconded the motion, which was cordially passed.

The Chairman, in his response, said the Directors would strain every nerve and make every effort to keep going until smooth waters were reached after the war.

The proceedings then ended.

MANAGEMENT OF THE STRATFORD-ON-AVON GAS-WORKS.

Mr. J. S. Cranmer Appointed Consultant Manager.

At the last monthly meeting of the Stratford-on-Avon Town Council, the Gas Committee recommended the appointment as Consultant Manager, at £125 per annum, of Mr. J. S. Cranmer (the Engineer and Manager of the Gas-Works), and the appointment of Mr. G. S. Kendall (his Assistant) as Manager, at £180 per annum, with house, gas, coal, &c.

Mr. BALLANCE, in proposing the adoption of the minutes of the Committee, said the members would remember that in the early part of 1915 the Gas Manager had a serious and somewhat protracted illness; and at the time some people thought there was very little likelihood of his recovery. Not only members of the Gas Committee, but other members of the corporate body, were delighted to find that Mr. Cranmer had sufficient vitality to deceive the doctor, and regain some measure of health and strength; but in the meantime it was necessary to have someone in control at the gas-works. On March 9, 1915, at a meeting of the Gas Committee, Mr. Kendall was appointed Assistant to the Manager at a salary of £150, with three months' notice on either side; and it was also resolved that the salary of the present Manager should be reconsidered in March, 1916. The time had, therefore, arrived for the consideration of the salary; and the Committee had gone thoroughly into the matter, and made the recommendations contained in the minutes. Mr. Cranmer was appointed by the Directors of the Gas Company in 1875. The Local Board took over the works in 1879. The make of gas had increased from 17 millions in 1875 to 82 millions in 1915; while the price of gas had been reduced from 4s. 7d., 4s. 2d., 4s., and 3s. 9d. per 1000 cubic feet (an average of 4s. 1½d.) in 1879 to 2s. 10d., 2s. 8d., and 2s. 6d. (an average of 2s. 8d.) in 1915. The number of consumers had increased from about 600 in 1875 to 1450 ordinary and over 900 prepayment meters in 1915. The gross income in 1880, which was the first full year the Corporation had the works, amounted to £6172; and for the year ended 1915 it was £14,777. In the same period, there had been paid into the following accounts: Interest on debentures, £24,710; annuities, £15,319; sinking fund, £26,414; general district rate, £23,810—the present capital being £24,130. During the whole of this time, Mr. Cranmer had carried out numerous alterations and additions to the works necessary to meet the increased consumption of gas, without any additional remuneration. He had had two advances of £25 in 35 years; and no one would charge the Corporation with extravagance or generosity in the way in which they had treated their Gas Manager in the past. Personally he did not think Mr. Cranmer had had full justice. If they appointed, as was proposed, a vigorous young man to take over the active managership, and retained Mr. Cranmer to advise them, he thought the Corporation would be doing a wise thing. [Hear, hear.] He (the speaker) had been on the Gas Committee for eighteen years, and had come to the conclusion that Mr. Cranmer was an excellent Gas Manager, who had had the interests and welfare of the works at heart; and he believed he would be supported in this view by his predecessors.

Mr. COX, in seconding, associated himself with all that Mr. Ballance had said.

Mr. SMITH moved, as an amendment, that Mr. Cranmer's salary be £100 a year. He said Mr. Cranmer had gone on six years beyond the age limit of poor-law officers (65) at full pay, and was now a man of 71. He intended no reflection on the Manager's services, but had taken the superannuation of the poor law officers as the basis of his proposal.

Mr. BULLARD seconded, but declared that he would rather have entertained a proposal to give Mr. Cranmer a lump sum. This was creating a new office; and if Mr. Kendall had been given a free hand, it would have been very much better for him.

Mr. WINTER explained that the recommendation of the Committee was really a compromise. Some members thought Mr. Cranmer should receive more than £125, and others less; and he told Mr. Smith that if he moved an amendment to pay £100, he (the speaker) would feel it his duty to propose that the amount be £150. Those who had been associated with Mr. Cranmer—and he himself had for several years as Chairman of the Gas Committee—could bear testimony to the deep interest he had always taken in the work of the gas department. The figures quoted by Mr. Ballance, in fact, bore eloquent testimony to the work accomplished by the Manager.

Mr. EVERARD endorsed what Mr. Winter had said as to the value placed upon Mr. Cranmer's services. It was an excellent idea that he should be appointed Consultant Manager. It would be a good thing for Mr. Cranmer, and for the town.

After some further remarks, the amendment was put, and lost.

Mr. WINTER then proposed that Mr. Cranmer's salary be £150.

Mr. BALLANCE (answering a question) stated that the salary now paid him was £250, with house, coal, and gas—valued at another £50. For a great many years, the Manager's salary had been less than that paid at many towns of a similar size; and he was now asked to vacate his house.

On being put to the vote, this proposition was carried by fourteen votes to three; and the minutes, as amended, were then approved.

Salford Water Supply.—Following the lead given by the Manchester Corporation Water-Works Committee in reducing the discount on water-rates for weekly houses, the Salford Water Committee have decided that, from and after June 24, the discounts on water-rates for weekly property within the township of Salford, of the annual value of £10 and upwards, be reduced from 20 to 5 per cent.; and the Town Council have approved the Committee's recommendation. In the course of a lengthy report to his Committee on the subject, the Superintendent of the Water Department (Mr. L. H. A. Gaunt) recommended the increased charges for domestic property.

THE PAST YEAR AT BLACKBURN.

Mr. A. Morton Fyffe has, as Engineer and General Manager, submitted to the Gas Committee his first annual report on the work done and the results obtained in the Blackburn Corporation Gas Department during the year ended March 25.

The financial result of the year's working is a net profit of £5229, after meeting interest and sinking fund charges amounting to £33,129. Full allowance for depreciation and depleted stocks has been made; and all new mains, meters, and fittings have been paid for. The increase of 7d. per 1000 cubic feet made in the price of gas during the last half of the year has resulted in an increased revenue of £10,866, against which the increased cost of raw materials has amounted to £13,660 during the year. For the preceding financial year, the net loss on the working was £6618; and for the year 1913-14, the loss was £10,322. During the year there has been some unusual expenditure, and at one time it was intended to divide this over two or three years. But the financial result of the year's working has been so satisfactory that the items referred to have been entirely paid off, and nothing whatever has been carried forward as a debit to next year.

The technical results obtained during the year have, says Mr. Fyffe, in all respects been an improvement on those of the previous year; but they are still much inferior to what they should be, though until new plant is constructed good working results must not be expected. For every ton of coal used during the year an increased yield of gas, coke, tar, and sulphate has been obtained; while an increased production of carburetted water gas has been secured per gallon of oil used.

During the year, the average weekly number of employees has been 210, as compared with an average weekly number of 234 during the previous year. The total wages bill has been £19,411, which is a decrease of £1041.

There have been changes in the standard rates of wages in the town; and rates paid in the Gas Department have been altered in conformity therewith. This has involved increases costing £447 per annum. With the present plant, the gas supply of the town cannot be assured, and constant breakdowns are inevitable, owing to the dilapidated state of the works. On many occasions during the winter continuity of supply has only been obtained by the loyalty and energy of the employees under great difficulties.

The consumption of gas during the year was 768,060,000 cubic feet, as compared with 771,080,000 cubic feet the previous year; being a decrease of 3,020,000 cubic feet, or 0·39 per cent. The unaccounted-for gas equalled 8·7 per cent. The gas sold at special rates for power and industrial purposes amounted to 34,259,000 cubic feet, as compared with 26,484,200 cubic feet in the previous year. Gas-heated furnaces are in use for the heating of copper bands for shells, for the stoving of shells after being varnished, and for the tempering of tool steel, &c.

During the year, the department removed its offices from the Municipal Buildings in Victoria Street to the Town Hall, where a commodious suite of offices has been constructed for the work of the department; and these have already proved to be a great advantage to the efficient carrying on of the work and for the convenience of the public. New showrooms were opened on Dec. 7, in Northgate. The premises are not large, but are sufficiently so when it is remembered that they are not in any way a storeroom but merely a showroom. Many of those visiting the showrooms recently have expressed surprise that the uses of gas are so numerous and so convenient; and the educational work done in this connection will be a very material advantage to the department. At the present time, the general depression of trade affects the sales of gas appliances; but since the showroom was opened the number of appliances sold shows an increase of 10 per cent. over the same period last year. The showroom is being advertised in the local newspapers by arrangement with the British Commercial Gas Association, with which the Blackburn Corporation have become affiliated, on condition that one-third of the Blackburn subscription is spent in advertising in the local newspapers.

There are now 2739 public gas-lamps in the area; but at present, owing to the restricted lighting order, only 193 are lit each night. As a result of the reduction in lighting, the number of employees in this department has been reduced from 50 to 18.

The assessable value of the undertaking was much too high; and negotiations have been conducted with the Assessment Committee of the Board of Guardians, who, along with their officials, met the Corporation in a very reasonable and businesslike manner, with the result that the rateable value has been reduced from £22,199 to £12,635, at which figure it now stands. This valuation is probably a little higher than it should be; but, considering all the circumstances of the case, the result of the negotiations is extremely satisfactory.

At the beginning of the financial year, 37 employees of the Department had left temporarily to join His Majesty's forces. During the year 23 more left. So that at the present time 60 of the Gas Department employees are in the Army; and the weekly payments to their dependants total £22. The amount of allowances paid to dependants of employees has been £1210 for the financial year, as compared with £322 for the previous year.

Considering the difficulties which have had to be encountered, Mr. Fyffe remarks in conclusion, the department has had a satisfactory year; but it must not be forgotten that the gas supply is only being maintained with great difficulty, owing to the condition of the plant, and that economical and efficient working is impossible under present circumstances. To improve these conditions, it will be necessary to expend considerable sums of money on renewals and on the introduction of modern plant; and the financial provisions necessary for this purpose should engage the earliest attention of the Committee. There can be no doubt that this expenditure will be a good investment in every sense of the word, as it will make it possible to effect economies which will more than meet the capital charges involved, and will thus enable the department to supply gas in increased quantities and at a reduced price. Both these changes will be to the advantage of the consumers and the whole of the community, for whose convenience and service the department exists.

LEICESTER GAS-WORKS ACCOUNTS.

It appears from the analysis of the accounts of the Leicester Corporation Gas Department for the year 1915, which has been prepared by Mr. Hubert Pooley (the Engineer and Manager), that the capital outstanding amounts to £985,267, which is at the rate of £5 7s. 1d. per ton of coal carbonized, and 8s. 11d. per 1000 cubic feet of gas sold. During the year, 162,249 tons of coal were carbonized; and oil was used equivalent to 21,703 tons of coal. Of a total make of 2,303,852,000 cubic feet of gas, 2,204,666,857 feet were sold. The make of gas per ton of coal carbonized was 12,524 cubic feet, and the sale (average illuminating power 14·26 candles) 11,985 cubic feet. The gas sold was 95·69 per cent. of the output; that used on works, 0·69 per cent.; and that unaccounted-for, 3·62 per cent. The amount of coke sold per ton of coal (only) carbonized was 11·42 cwt., and of sulphate of ammonia 25·77 lbs.; the net proceeds of all the residuals being 56·93 per cent. of the cost of coal. The net cost of coal per ton carbonized was 6s. 8·34d.

GAS-WORKS RESULTS AT MANCHESTER.

Statements submitted to the Manchester Corporation Gas Committee at a special meeting last Wednesday—Alderman W. Kay in the chair—showed that the gross profits for the year just ended amounted to £175,265, as compared with the estimate of £150,248—an increase of £25,017. This result is arrived at after making full provision for renewals of plant, amounting to £66,447, for the year. The total income for the year amounted to £932,739, as compared with the estimate of £913,700. The capital employed was £3,094,838, in respect of which the outstanding loan debt is £973,373. The gross profit has been appropriated as follows: To meet the deficit brought from the previous year £52,708, for interest £41,477, statutory sinking fund for redemption of mortgage debt £63,163, contribution to city fund in aid of rates £50,000, and to cover capital outlay not chargeable against borrowing powers £8935. The excess appropriation, amounting to £41,018, has been carried to next year's account. The increase in the gross profits is attributable mainly to higher prices realized for coke and other residuals. The income from gas has been satisfactory, notwithstanding a decrease of slightly over 3 per cent. in the quantity sold consequent upon the lighting order and war conditions generally.

The forecast for the financial year just commenced is by no means promising. The figures submitted showed that, with gas at present prices—which it should be noted are low when compared with those of other undertakings similarly situated—and after meeting all commitments, including a further contribution of £50,000 to the city fund in aid of the rates, the Committee will be faced at the end of the year with a deficit of no less than £120,770. This will arise mainly through the increased cost of coal and oil for carbonization and of other materials. Income-tax, war service allowances, &c., to employees, and interest will also be appreciably higher. Incidentally it may be pointed out in connection with income-tax that, of the £25,000 returned as the tax payable by the gas undertaking, £12,500, or practically one half, is consequent upon the present system of contributing gas profits to the relief of the rates. The estimated total income for the year is put at £973,800, and the expenditure, before meeting loan charges, at £890,505; showing a gross profit of £83,295, compared with £175,265 for the previous year. The whole of the gross profits will be more than exhausted by the following commitments, which will have to be met during the year; thus leaving a deficit of £120,770, as already stated: To meet the deficit from last year £41,018, interest £44,000, statutory sinking fund for redemption of debt £61,047, contribution to city fund in aid of rates £50,000, capital expenditure to be met out of revenue £8000.

A report upon the position prepared by the Superintendent of the department (Mr. F. A. Price) shows that, in the year ended March 31 6068 million cubic feet of gas were consumed, as compared with 6233 millions in the preceding year—a decrease of 2·65 per cent. This decrease, he says, is attributable to the lighting order, under which the lighting of the public street lamps and private lights has been restricted. The early closing of public houses has also been a factor in the decreased consumption. It is estimated that, had no restrictions been in force, the year's working would have shown an increase of 2½ per cent. While the night consumption decreased by 7 per cent., the day consumption increased by 5 per cent., owing to the use of cookers and gas-furnaces for manufacturing purposes.

There has been in the year an increase of 5804 in the number of cookers fixed, 695 in the number of grillers, and 3428 in the number of fires. The number of these gas-consuming devices at March 31 was: Cookers, 86,137; grillers, 37,661; and fires, 20,511; total, 144,309. The year began with 189,201 customers, and it ended with 191,190, of whom 74,740 are consumers through automatic meters.

With regard to financial results, Mr. Price points out that the year commenced with an adverse balance of £52,708; and notwithstanding the advance of 6d. per 1000 cubic feet which took effect from June 24, 1915, the year ended with an adverse balance of £41,018. This is the result after providing as usual for renewals of plant, redemption of debt, interest on loans, payment to the city fund of £50,000 in relief of the rates, and capital expenditure other than out of loans. There is no balance in the reserve fund, as this was exhausted last year. The estimates for the year ending March 31, 1917, show that at the present prices the adverse balance at the end of the year is calculated to be about £120,000. "The future financing of the department will require very serious consideration. It is self-evident that we cannot continue to pay £50,000 a year to the rates, and also income-tax, amounting, on the estimated profits, to £25,000."

Some £20 shares in the Sittingbourne Gas Company have been sold by auction at £22 each.

MIDDLESBROUGH GAS-WORKS MANAGEMENT.

There was more acrimonious discussion relative to the management of the Middlesbrough Corporation Gas-Works at the meeting of the Gas and Electricity Committee last Tuesday.

An employee in the clerical department at the gas-works had received notice from Mr. David Terrace (the Manager) for alleged insubordination; and his case had been taken up by the Municipal Employees' Association, who had asked for an interview with the Committee. This had been granted; and accordingly, the man appeared, and proceeded to make allegations against the management. Many members protested against these—including the Mayor (Mr. J. Calvert), who is Chairman of the Committee. Mr. Terrace and his Assistant (Mr. C. T. Blencoe) replied to the statements; and the Committee confirmed the Manager's action.

Alderman Archibald thereupon moved that Messrs. Terrace and Blencoe should also be asked to terminate their services at the end of the period fixed by the Corporation for the continuance of the present arrangement. Mr. Turford seconded. Mr. Calvert again defended these officials. They were being done a great injustice, he said; and if the motion of Alderman Archibald was carried, he would be no party to it, but would stand by the two gentlemen to the last. He paid high tribute to their capacity and outstanding ability, and assured the Committee that their dismissal would involve his retirement from the chair. After heated argument, the motion was put and was defeated by a large majority.

It may be remembered that last October, after a succession of animated discussions on the point as to whether Mr. Terrace should be made Consulting Engineer at £250 per annum, and Mr. Blencoe be Manager at £300, the Corporation decided that the arrangements then obtaining should remain undisturbed for twelve months.

SPONTANEOUS COMBUSTION OF COAL IN MINES.

Departmental Committee's Inquiry.

Some time before the war, a Home Office Departmental Committee was appointed to inquire into the circumstances in which spontaneous combustion of coal occurs in mines, its causes, and the means of preventing it or of dealing with it when it has arisen. The Chairman was Mr. (now Sir) R. A. S. Redmayne, C.B., the Chief Inspector of Mines; and the other members of the Committee were Sir Arthur B. Markham, Bart, M.P., Mr. C. E. Rhodes, Mr. Frank Rigby, and Mr. Herbert Smith. The Committee duly presented their first report; but (no doubt owing to delays caused through the international crisis) it was not until earlier this month that the evidence which led up to the report was published. This evidence was given at ten sittings; and among the twenty-six witnesses examined were a number of well-known experts.

The portion of the inquiry which this first report of the Committee covered was that relating to the danger to persons employed in a mine during the occurrence of an underground fire occasioned by the spontaneous combustion of coal or other carbonaceous material. The Committee remarked that the greatest danger from spontaneous combustion occurs in mines which generate large quantities of firedamp. Fortunately, however, mines characterized by both of these features—generation of firedamp and liability to spontaneous combustion—are not so numerous as those in which only one or other exists. Though there are a very large number of mines usually described as "fiery," in only two districts are such mines liable to spontaneous combustion to any considerable degree—in North Staffordshire and Yorkshire. On the other hand, though the majority of the mines in South Staffordshire and East Worcestershire are liable to spontaneous combustion, few of them can be termed "gassy." The Committee included several practical recommendations in the report. These had reference to the stage at which abnormal heating should be reported to the Inspector of Mines, and the rules to be observed with regard to the withdrawal of workmen from a mine or part of a mine on the outbreak of fire, or during the operations of dealing with the fire.

The first three days of the inquiry were occupied by hearing evidence, detailing experiences of fires and general working practices adopted, of officials connected with the Talk-o'-th'-Hill Colliery, Stoke-on-Trent, and the Mossfield Colliery, the Skelton Coal and Iron Company's Collieries, the Birchenwood Collieries, and the Bignall Hill Collieries—all in North Staffordshire. This was supplemented by the experiences on these matters of Mr. G. Poole, in his capacity of Inspector of Mines.

Dr. *R. V. Wheeler*, the Chief Chemist at the Home Office Experimental Station, Eskmeals, Cumberland, who was the first witness called on the fourth day, said he had investigated the subject of colliery explosions, and in this connection had had to consider the spontaneous ignition of coal. He started out with the assumption that it had been practically proved now that the self-heating of coal was not due necessarily to the presence of large quantities of pyrites in the coal, but to an actual combination of oxygen with the coal substance. He was quite satisfied that this was a right assumption. Pyrites might, however, have an influence, if the coal contained a considerable quantity of it, inasmuch as when moisture came to it the pyrites would cause the coal to split up into small fragments, and would therefore render it more open to attack by the oxygen of the air. What he would say was that it was unnecessary to assume that pyrites was the cause of the spontaneous combustion of coal, because there was a sufficient cause in the oxidation of the coal itself. Taking different coals, and ascertaining their chemical composition, one found a rather remarkable relationship between this chemical composition and the ease with which they could be made to "self-heat." The relationship seemed to be that the higher the oxygen-content of the coal, the more readily the coal self-heated. By oxygen-content, he did not mean oxygen present in the coal as the gas oxygen, but present in combination with other bodies forming a

chemical compound. The amount of oxygen in different coals varied between very wide limits—between 1 per cent. by weight in anthracite coals, up to 17 or 20 per cent. by weight in some bituminous coals. With very few exceptions, the higher the percentage of oxygen that a coal contained, the lower was the temperature at which self ignition of the coal took place. He was speaking from the chemical point of view. It did not seem to him that a high percentage of volatile matter in a coal would necessarily render it likely to self-heat easily; while, as far as he could judge, the moisture appeared to make very little difference. He had had some interesting samples of coals which had self-heated when they had been stacked, and each one of them had had a very high oxygen-content.

Sir A. MARKHAM: How are the oxygen contents determined?

Witness replied that they had to be determined by difference. It was necessary to determine by weight the percentage of every other element in the coal, and subtract their total from 100. The difference must be oxygen, because the only important constituents were carbon, hydrogen, nitrogen, sulphur, and oxygen. There were traces of phosphorus and arsenic; but the quantity was negligible. So that when one had determined the percentages of carbon, hydrogen, nitrogen, and sulphur, the difference was taken as being the percentage of oxygen. Really, he would not like to say that the main factor in the spontaneous combustion of coal was its chemical composition. Probably there might be a coal of exactly the same chemical composition in two different mines, and in one mine it would be found liable to fires, and in another not. But it should be possible to see exactly what was the difference in the methods of working, or in the condition in which the coal existed in these two mines; then one would be able to find out what was the extra factor which was liable to cause fires in the mine.

The CHAIRMAN: You have a whole county like Durham, with never a known case, one of the oldest fields, worked since the time of Henry III., and every method of working one could think of pursued. Some parts are very faulty, some not at all; and with seams of different thicknesses. Then you come to a place like South Staffordshire, where there is hardly a colliery in its history that has not had several fires.

Witness remarked that he did not know what was the main difference between the analyses. It would be a very useful thing to have whole series of analyses of the Durham and Staffordshire coals, to see how they compared. This would prove whether or not there was anything in his idea. As to the mode of combustion which took place, it was generally known that, when freshly-won coal was exposed to air or oxygen at atmospheric temperature, a considerable volume of oxygen was apparently absorbed. He had made some experiments with the continuous circulation through finely-powdered coal, packed in a glass tube, of pure oxygen; the coal being maintained at a constant temperature. The rate of absorption of oxygen under different conditions had been measured, and the composition of the gases produced examined. Freshly-won coal was used, which was an important point. The rapidity with which the absorptive power of the coal fell-off after short exposure to the air was remarkable. In general his results had shown two distinct reactions that had taken place when the coal was exposed to oxygen. There was an occlusion or condensation of oxygen, as oxygen, inside the coal. This was accompanied by a slight evolution of heat, so that it might be a factor in causing the ultimate heating-up of coal, though the amount of heat that was given out when oxygen was occluded by coal was comparatively small. It was a physical action. All the oxygen that was condensed in this way by coal one could remove from the coal again. There had been some work done in France by Boudouard, who came to the conclusion that part of the action of air on coal was to oxidize the "humic" substances in the coal. Witness was not quite clear what the "humic substances in the coal" were supposed to be; but he believed they were somewhat of the same nature as were found in rotten wood. In some of his experiments, he could not see that there was any difference in the rate of absorption of oxygen, whether the coal had its natural moisture in, or whether it was extracted; but lately he had made other investigations, as the result of which he would not like to say definitely now that moisture had no effect. Potter had made some experiments which were very striking. He showed (and witness did not see any fault in the experiments) that, if coal was kept under conditions which were not favourable to bacterial life, there was no oxidation of this coal. The conclusions were given in 1908 by Potter before the Royal Society. It seemed to witness that the research was one which was well worth going on with. He would say that, if one regarded all the coals as being under the same form of treatment in the mines, it was possible to tell whether or not a coal was liable to spontaneous combustion. He did not think there was any relation between the rapid evolution of gas on distillation and the rapid absorption of oxygen.

Dr. *F. Phillips Bedson*, Professor of Chemistry at Armstrong College, who followed, said he took the line that spontaneous heating and ignition of coal was explicable in the same manner as spontaneous ignition of yellow phosphorus. In the first place, there would be the condensation, as it might be called, or the absorption of the air by the combustible body on its surface. The condensed oxygen would begin to attack any oxidizable materials with which it was brought in contact. The oxidation was associated with the production of heat; and unless means were taken for the dissipation of the heat, it would accumulate and gradually raise the temperature of the combustible body to the temperature of inflammation. When one had the slow combustion beginning in the way he had indicated, the oxidization would be more and more accelerated by the heat so developed, and thus become rapid combustion. The nature of the compounds forming coal varied very much indeed. Even in parts of the same field, or of the same seam, there were found coals of different composition and constitution; and he would attribute the firing which had been referred to as occurring in South Staffordshire to the existence in the coal of substances which were readily oxidized. So little was known about the constitution of the compounds contained in coals, that it was difficult to put a finger on any particular set as the source of this oxidation. He could not say that he attached very great importance in the problem to the presence of pyrites. The proportion of pyrites was small compared with the whole of the coal substance; and a large proportion of the coal substance must consist of easily oxidizable bodies. In investigating this question from a scientific point of view, he thought the proper thing would be to see whether by means of solvents any information could be obtained as to the nature of the compounds entering into the composition of the coal. Many years ago, he suggested the use of pyridine as a solvent. It might be found that pyridine would extract from a coal substances which would oxidize very readily on exposure to the air. He knew that one of the difficulties experienced in connection with the study of the constitution of the compounds entering into the composition of coal was the fact that these extracts, or the substances extracted, altered in composition on being brought into contact with the air. As to whether or not moisture entered into the question of ignition, he could not speak from experience.

Sir ARTHUR MARKHAM: Would you think if a coal were high in oxygen-content this would render it more liable to oxidation from the air than one with low oxygen-content, or that on artificial heating being induced in a coal having a high percentage of oxygen-content it would be more liable to spontaneous ignition than the one that had a low oxygen-content? It rather comes back to these possible compounds, of which we know so little?

Witness: Yes. As a guide in that direction, the experiments of Fayol show, for instance, that a brown coal has the lowest temperature of ignition of the whole series. That is lignite; and the temperature of inflammation of lignite is 150° C. Fayol puts the temperature of inflammation for gas coal at 200°; for coking coal at 250°; and for anthracite at 300°. It is very difficult to form any judgment in a matter of this kind from merely ultimate composition. The statement that I have referred to indicates that the high oxygen-content is associated with a low temperature of inflammation, compared with an anthracite, which is of a low oxygen-content; but I do not think they are comparable. They are coals; and that is the only thing that brings them together. The word "coal" is used in such a wide sense.

The CHAIRMAN: You say, although our knowledge of the composition and constitution of the approximate constituents of coal is in a very unsatisfactory state, still there is evidence of the presence in coal of substances which chemists speak of as unsaturated compounds; and these will undoubtedly combine with absorbed oxygen to form stable substances. Further, such changes must be associated with heat production. That, again, brings us back to the point that this is rather the line on which we want to work. There may be these unstable compounds in coal, and the very fact of their becoming stable, or being made stable substances through the absorption of oxygen, may be the chemistry of the production of heat?

Witness: It is one of the factors in the problem, there is no doubt. The iodine absorption value in a coal might give information as to whether or not coal contains a considerable proportion of these unsaturated compounds.

Continuing his evidence, witness said that, of course, in the chemical nature of coals themselves there was sufficient to explain the large proportion of the oxygen absorbed. He did not think it was likely to be entirely physical. He did not recall any case in which heating had been more rapid with pyrites present than without; but he knew there were experiments cited to show that it was a matter of indifference whether the coal was a pyritic coal or a non-pyritic one. It heated up just the same. As to the suggested influence of bacteria in originating self-heating of coal, it would be wrong of him to, as it were, dismiss the subject without consideration; but from the fact that there was in coal material which it was known readily absorbed oxygen—oxidizable material—he did not think it was necessary to go to the bacteria for assistance. This idea of fermentation changes in the coal had been started years ago; but he did not think there was any reason for entertaining it. Seeing there were the unstable compounds he had referred to, these presented the most fruitful source of investigation. He would not like to express an opinion on the point as to whether the rate of absorption of oxygen in coal was accelerated or retarded by moisture. Asked whether he could indicate any scientific men who held the view that pyrites played an important part in the matter they were discussing,

Sir ARTHUR MARKHAM said: Dr. Haldane, by recent experiments, finds that by adding pyrites to coal dust, the power of absorbing oxygen has enormously increased; and the coal takes up this oxygen at a very rapid rate. This being so, pyrites would seem to my mind to be a primary cause of these troubles?

Witness: Of course, you will have to prove the presence of pyrites in all these coals which do spontaneously ignite.

As to the importance to be attached to the question of moisture being present, you are probably aware that there have been tests made where gas coal has been accumulated during the summer months, and where it invariably fired when it was exposed to the air and to the rain; but when it has been put into a shed and excluded from the air, although housed in very large quantities it never has fired, or even heated?—Of course, there are a number of statements on this, and some contradictory ones, too, have been made; but I have no opinion at all, and should not care to express one.

There are coals with moisture ranging from 4 up to 8 per cent., and with oxygen ranging from 4 up to nearly 12 per cent.; and it appears that the oxygen rises in a percentage almost identical with the rising moisture. Is there any connection between the two factors, that the oxygen and the moisture should rise together?—I do not see that there should be.

Mr. RHODES: Supposing you used water to put out a gob fire, and put the fire out, would not the moisture that was left in the goaf bring about a condition of things by which you could again have a fire set up by giving additional facilities for absorbing oxygen?

Witness: I should think probably it would contribute. In a case like that, I should say that pyrites would come into play. It would contribute a little, because the pyrites would oxidize practically in a drowned condition.

Mr. *F. J. Meacham*, a mining engineer connected with South Staffordshire, said he had never known spontaneous combustion to take place in a mine in a seam of under 4 feet in thickness. Some seams in which there was extremely little pyrites would fire very quickly. There was no thick coal working in South Staffordshire where spontaneous combustion did not occur. As to fires, experience showed in the case of the pits with which he was connected that if they could by any means reduce the oxygen down to about 16 per cent., the whole thing stopped.

No doubt, in other places fires had gone on with a lower percentage than this. The physical structure of the coal had an important bearing on the question of fires. Though there might be a strong opinion among scientific men that pyrites had an influence, he placed more importance on the absorption of oxygen by the coal itself. If it could be proved that the addition of pyrites caused the coal to absorb oxygen more rapidly, he would then take the pyrites as being one of the factors.

Mr. RIGBY: You referred to the mechanical action producing heat. Do you distinguish at all between the rise of temperature due to mechanical action and that due to oxidation?

Witness: No; I cannot distinguish between these two. You get the grinding, and so on; and then, after the face has got broken, you begin to have heating-up. The two seem to go on simultaneously. First, it is ground up into fine slack, and then there is the oxidation.

[The next witness was Dr. W. A. Bone, some notes from whose evidence will be given later.]

VISIT TO THE WOMBWELL GAS-WORKS,

To Inspect the Crude Benzol Plant.

Last Thursday week, on the invitation of the Wombwell Urban District Council, the members of the Yorkshire Commercial Section of the Manchester District Institution of Gas Engineers visited the Wombwell Gas-Works to inspect the crude benzol plant recently installed there. The visitors were met by Mr. A. E. Allott, J.P., the Chairman of the Council, Mr. J. E. Mitchell, the Chairman of the Gas and Water Committee, Mr. P. D. Walmsley, the Gas and Water Engineer, and the Clerk to the Council, Mr. P. M. Walker. The gathering included Mr. F. L. Halford, representing the Ministry of Munitions, Mr. John Young, the President of the Institution of Gas Engineers, Mr. W. Doig Gibb (late Chief Engineer of the South Metropolitan Gas Company), Mr. Charles Wood, of Bradford, and Messrs. T. H. Alderson, of Selby, H. Blakey, of Shipley, J. W. Brearley, of Swinton, H. E. Bloor, of York, A. E. Buckley, of Holmfirth, H. Davies, of Brighouse, G. W. Fligg, of Dewsbury, H. Hutchinson, of Barnsley, W. J. Hartley, of Gomersal, William Hallett, the Chairman of the Wath and Bolton Gas Board, J. Ledger, of Hawksworth, Bolton, C. H. Hutchinson, of Barnsley, William Jonas, of Earby, A. L. Jennings, of Cleckheaton, G. W. Lupton, of Otley, W. H. Mainwaring, of Lincoln, Arnold E. Mottram, of Ossett, L. W. Nuttall, of Goole, Fred H. Pickles, of Kildwick, Frank H. Robinson, of Harrogate, Julian Stephenson, of Bingley, W. Stenton, of Elsecar, John W. Turner, of Mirfield, J. W. Thompson, of Barnoldswick, Robert Watson, of Doncaster, J. H. Woodward, of Skipton, G. Neville Wright, of Wath, and E. O. Watson, of Rawmarsh.

Mr. ALLOTT, on behalf of the Wombwell District Council, in a few well-chosen words, welcomed the visitors to Wombwell, and hoped their visit would be full of profit, and result in the undertakings represented by the members adopting some such process as that in operation at Wombwell, and so help the country in its present pressing need. He remarked that the greatest possible credit was due to the Chairman of the Gas Committee (Mr. Mitchell) and the Manager (Mr. Walmsley) for their initiative in putting forward the process at Wombwell. When the matter was first mentioned to the Council, the members were unanimous in their decision to adopt the process from a patriotic point of view; and no questions were raised as to what the plant was going to cost, or what the Council were going to get out of it. He certainly thought some little credit was due to the Wombwell Gas Committee in this matter.

Mr. HALFORD, on behalf of the Ministry of Munitions, expressed his pleasure at meeting such a representative gathering of engineers, and pointed out the importance of every effort being made to satisfy the requirements of the Ministry of Munitions, in the matter indicated by Mr. Allott.

Mr. MITCHELL expressed his pleasure at the gratifying response which had been given to the Council's invitation, and hoped that when the visitors had seen the plant at Wombwell, they would find sufficient materials to interest them, and cause them to go back to their different Boards and Committees, and recommend some such scheme as this at Wombwell. He was not a gas manager himself, and did not profess an extensive knowledge of gas-works practice; but in bye-product coke work he had had some little experience, and his experience and that of Mr. Walmsley, who was a practical gas engineer, would be willingly placed at the disposal of members who might decide to go in for the scheme.

Mr. CHARLES WOOD, on behalf of the members of the Yorkshire Commercial Section, thanked the Chairman of the Council and the Chairman of the Gas Committee and the members of the Wombwell District Council for their kindness in inviting the members of the section and entertaining them in the manner hey had done. He said the visit was arranged quite unexpectedly at the meeting of the section in Bradford the previous Thursday, when several members expressed their desire to visit the plant, and Mr. Walmsley immediately, on behalf of his Council, invited the members to come as a body. Personally, he (Mr. Wood) thought that he could speak for every member present in saying that they had spent a very instructive afternoon, and they had seen that, even in a relatively small works such as Wombwell, developments could be made which might have very far-reaching results.

After light refreshments had been served at the town hall, the visitors proceeded to the gas-works to inspect the plant, the working of which was explained by Mr. Mitchell and Mr. Walmsley. They afterwards proceeded to the bye-product plant of the Mitchell Main Colliery to inspect the benzol rectification plant in operation at these works. The visitors, under the direction of Mr. Mitchell and Mr. Morfey, the Manager, were shown over the various parts of the plant.

PARKINSON'S "GACYLETTE"

HOT WATER for "WASHING UP,"

Also for WORKS and OFFICE LAVATORIES.

With Union for Cold Water, or open Top Inlet.

Hot Water always ready with extreme economy of gas.

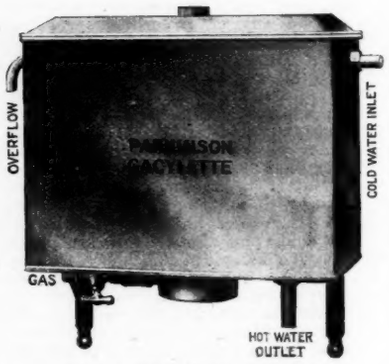
Gas automatically controlled according to temperature of water —no waste, no over-heating—no attention required.

Water kept at scalding heat with 1½ feet of gas per hour—or ½d. per day.

Always full of water—cannot be damaged by carelessness.

Easily and cheaply connected to Gas and Water Pipes.

Made in Copper, interior tinned, exterior japanned, or polished and lacquered.



Pattern "A," with Ball Valve.

IN SIZES HOLDING FROM 3 TO 10 GALLONS.

THE PARKINSON STOVE COMPANY, LTD. (Water Heater Section),

STECHFORD, BIRMINGHAM.

London Show-Rooms: 129, High Holborn, W.C.

BYE-PRODUCT RECOVERY RESEARCH.

The American Course of Study.

Recently in the "JOURNAL" it was mentioned that the Johns Hopkins University at Baltimore had determined to institute a course of study in "Gas Manufacture and Bye-Product Recovery." It will be under the care of the Department of Engineering; and it is announced that the work may be undertaken during the fourth year of the courses in mechanical, electrical, or civil engineering, and may be pursued as graduate study. The course is to be open to graduate students in either chemistry or engineering, and may be taken by such fourth year undergraduates in chemistry as are able to qualify for the work. It is considered "highly desirable" that those taking the course should have completed three years of undergraduate work in one of the branches of engineering.

The course involves essentially the study of the distillation of carbon and the utilization of all the products of the process. It deals with the principles underlying the gas industry, and the production of most of the chemicals used in the industries of the world. The work is taken up in both lecture room and laboratory, for which special equipment is being provided.

COURSES OF STUDY.

The following broad outline indicates the scope of the courses:

(*a*) The physical and chemical properties of gases, including fundamental laws of gases, kinetic theory, liquefaction, dissociation, viscosity and flow of gases, nature and velocity of chemical reactions, chemical equilibrium, influence of moisture, surface and pressure in gas reactions, occlusion of gases, principles of thermo-chemistry. The mechanism of combustion, ignition points, flames and explosions, combustion of carbon, carbon monoxide, carbon dioxide, cyanogen, hydrogen, and all hydrocarbons, thermal decomposition of hydrocarbons, action of steam on incandescent carbon.

(*b*) The technology of fuel, including the mechanical theory of heat, specific and latent heats, heat of combustion of solid and liquid fuels, calorimetry, principles of gas analysis and manipulation, preparation of pure gases, fractionation of gas mixtures, collection and storage of gas samples, solubility of gases in liquids. Discussion of solid, gaseous, and liquid fuels—coal, coke, lignite, natural gas, producer gas, coal gas, water gas, petroleum and other oil fuels.

(*c*) Bye-product coking processes. Description and theory of the various chambers and retorts used in the carbonization of coal.

(*d*) Details of manufacture and purification, methods of distributing, storing, and measuring gas, high and low pressure distribution.

(*e*) Economics of gas manufacture and distribution, financing, cost, accounting, rate-making.

THREE YEARS' STUDY.

It has been found by the University that it is decidedly advantageous for engineering students to delay specialization until the fourth year of their undergraduate course; and the engineering work is arranged accordingly. Opportunity is thus afforded for a thorough grounding in mathematics, physics, and chemistry, and for a study along various broadening lines before the student begins to devote his time to any one special field. In the third undergraduate year, each student takes courses in the elements of heat-power engineering, electrical engineering, and in the mechanics of structures.

FOURTH YEAR.

The new course in "gas manufacture and bye-products" is taken in the fourth year by those who desire to pursue the subject. Seventeen seniors and graduates are taking the work this year—the lectures being delivered by Captain F. H. Wagner, the Chief Engineer of the Bartlett-Hayward Company. Mr. Wagner is devoting the necessary time to this work because of his interest in seeing adequate facilities afforded at the University for instruction and research in this subject. It is hoped to erect a small coal-gas plant of one retort capacity (especially adapted for research work) in the laboratories of the University.

RESEARCH.

It is the intention of the Department of Engineering to publish monographs covering the work done—copies to be distributed to those interested as soon as issued. Besides this, the facilities of the laboratory will be available as far as possible for such special research work as may be of interest to the gas industry; full reports of results secured being published as soon as completed.

Unusual facilities are said to be available in Baltimore and vicinity for studying the practical operation of bye-product plants, as well as gas manufacturing plants; and the location is especially favourable for the experimental coal-gas plant at the Johns Hopkins University.

Export of Gas-Meters from Sweden Prohibited.—The Board of Trade are in receipt, through the Foreign Office, of information from H.M. Minister at Stockholm to the effect that the exportation of various articles from Sweden has been prohibited—among them gas-meters—as from the 7th inst.

Bombay Gas Company, Limited.—At the meeting of the Company on Thursday, the 4th prox., when the Directors will submit the accounts for the year ended Dec. 31, they will report that there has been a slight decrease in the sales of gas due to the state of trade in Bombay, which was adversely affected by the war. In the latter months of the year, however, the sales showed a satisfactory increase over those in the same period of 1914. The profit for the year, as shown by the net revenue account, after allowing for interest and exchange, amounts to £22,226, making, with £9379 brought forward from the previous year, £31,605 available for dividend. Deducting the interim dividend paid in November last (£8400) and placing £814 to reserve, there remains £22,391, out of which the Directors recommend a dividend of 4½ per cent. (less income-tax), making 7½ per cent. for the year, which will leave £9790 to be carried forward.

Main Matters.

THE swelling popularity of the "Main" Gas Cookers is explained by their true qualities. While they are made in many different sizes and designs, they are all similar in that they are reliable, durable, and of real value. Mains are the cooker experts and are equipped to deal with every class of cooker business. Let them deal with yours.

R. & A. MAIN, LIMITED.

WORKS: Gothic Works, EDMONTON, N.; Gothic Ironworks, FALKIRK; and Gothic Works, BIRMINGHAM.
SHOW-ROOMS AND BRANCHES: 25, Princes Street, Oxford Circus, W.; 136, Renfield Street, GLASGOW; 83, Old Market Street, BRISTOL; 18, Severn Street, Deansgate, MANCHESTER; 97, Millfield, BELFAST; 333, Queen Street, MELBOURNE; and 12, Cunningham Lane, Pitt Street, SYDNEY, N.S.W.

NOTES FROM SCOTLAND.

Visit to the Glasgow Gas Department Workshops.—On the invitation of the Gas Committee, the students attending the "Gas-Fitting and Plumbing" classes of the Royal Technical College, Glasgow, visited the Glasgow Corporation Gas Department workshops, in Walls Street, last Saturday week, to inspect the machinery and plant used for the repairing and testing of meters, &c. There was a large attendance of students, who were accompanied by Mr. J. Somerville (the Convener of the Sales and Distribution Committee) and Mr. F. W. Raynes (of the Royal Technical College); and the visit proved highly interesting and instructive. The company were received by Mr. Ralph Halkett (the Commercial Superintendent of the Gas Sales and Distribution Department) and Mr. James M'Ghee (the Workshop Superintendent), and conducted through the place. After tea, Mr. Somerville gave the results of the recent "Gas Fitting and Plumbing" examination, and referred to the high standard of efficiency attained by the students. The encouraging results of the examinations were chiefly due to the careful tuition of Mr. Raynes and Mr. M'Ghee. Mr. Raynes returned thanks for the assistance and encouragement given by Mr. Halkett and the Gas Department staff during the past session. Mr. Halkett then referred to the great benefits to be derived by young students attending these classes, and pointed out the opportunity afforded them to educate themselves in their particular class of trade. The Gas Department workshop gave them a unique opportunity of viewing the different gas appliances, and how they should be fixed and adjusted. He also spoke of the great strides made by the Distribution Department during the past few years, and how the trade had assisted him to meet the extra demand for appliances. Mr. M'Ghee, in proposing a vote of thanks to Mr. Somerville, spoke of the great interest the Councillor had always taken in the classes.

"Dutch" Gas Mantles Case.—In the "JOURNAL" for Feb. 8, it was reported that some cases of incandescent mantles, consigned by a Dutch firm to an Edinburgh agent, had been confiscated by order of the Edinburgh Sheriff Court, and that the defendant (Michaelson) was contemplating appealing against the decision. On Wednesday last, Counsel were heard by Lord Dundas in the Bill Chamber of the Court of Session in an appeal against the judgment of the Sheriff. His Lordship, however, held that everything had been done not only regularly, but fairly, in the Court below, and refused the appeal.

Air-Raid Precautions in Edinburgh and Leith.—It was stated in last week's "Notes" that the Gas Commissioners were to make some experiments in reducing the pressure of gas, in order to ascertain if such a method of warning against air-raids were feasible. Before, however, these experiments could be carried out, the Commissioners received a letter from the Commander of the Scottish Coast Defences (Major-General Gardiner), in which he instructed them, on receipt of a certain message, "to reduce the pressure of gas in the mains and service-pipes as much as is consistent with the public safety." A meeting of the Works Committee was summoned for Thursday last, when, after full discussion, in which the Committee had the assistance of the Consulting Engineer (Mr. W. R. Herring), it was agreed to recommend the Commissioners to instruct their Engineers, after advertisement, to ascertain the effect of a certain reduction of pressure of gas with a view to finding out whether by such means a suitable warning could be given to the public of anticipated air-raids; and that the Corporations of Edinburgh and Leith and the county authorities be asked to assist in giving due notice of the experiment. At a special meeting of the Commissioners which followed the Committee meeting, the recommendation was approved.

CURRENT SALES OF GAS PRODUCTS.

The London Market for Tar, Tar Products, and Sulphate.

LONDON, *April* 22.

The market for tar products is steady. Pitch remains unchanged at 19s. to 19s. 6d. per ton, net, in bulk, at makers' works, and fair amounts continue to be shipped. Tar for road work is active, and large quantities have already been delivered. Solvent naphtha is in fair demand, and the price is firm at 2s. 2d. per gallon, net, and naked, for 90 160 quality. Creosote is 4d. to 4⅛d. per gallon, net, in bulk, at makers' works.

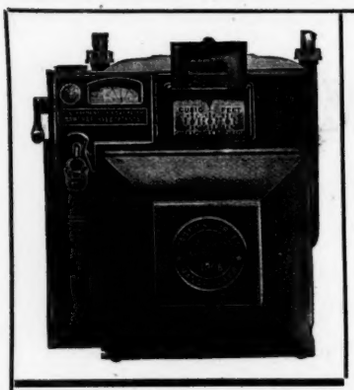
Sulphate of ammonia remains about the same, and the price for 25 per cent. quality is nominal at £17 5s. per ton, net, into buyers' bags, at makers' works.

Tar Products in the Provinces.

April 25.

There is no alteration in the markets for tar products. Pitch remains in the same position as last reported. Creosote is still very quiet, and little or no business doing. Solvent naphtha is steady, but there appears to be plenty of the article offering. Heavy naphtha is in good demand.

The average values of gas-works products during the past week were: Gas-works coal tar, 15s. 6d. to 19s. 6d. Pitch, East Coast, 15s. to 15s. 6d. per ton; West Coast, 14s. to 14s. 6d. Manchester; 15s. to 15s. 6d. Liverpool; 17s. to 17s. 6d. Clyde. Benzol, 90 per cent., North, 10½d. to 11½d.; 50-90 per cent., naked, North, 1s. 3d. to 1s. 4d. Toluol, naked, North, 2s. 3d. Coal tar crude naphtha, in bulk, North, 6½d. to 7d. Solvent naphtha, naked, North, 2s. Heavy naphtha, naked, North, 1s. 2d. to 1s. 3d. Creosote, in bulk, North, 2¼d. to 2½d. Heavy oils, in bulk, 3⅝d. to 4d. Carbolic acid, 60 per cent., East and West Coasts, 3s. 4d. naked. Naphthalene, salts, 80s., bags included. Anthracene, "A" quality, 2d. to 2½d. per unit; "B" quality, nominally ¾d.



The "Positive"

"THE METER OF MANY MERITS."

SAWER & PURVES, BRANCH OF METERS LTD.

MILES PLATTING, MANCHESTER.

RADFORD ROAD, NOTTINGHAM.

Agent for Scotland: JNO. D. GIBSON, 2, CAUSEYSIDE STREET, PAISLEY.

Manchester Tar Prices.

The average price realized for tar—based on the value of the products—for March deliveries in the Manchester district was 21s. 10d.

Sulphate of Ammonia in the Provinces.

LIVERPOOL, *April* 20.

Throughout the week the market for this material has been of a desultory nature, little buying or selling interest having been shown; and values have remained unchanged. Export licences have been given out more freely; but in most cases the quantities applied for have been halved by the authorities. The closing quotations are still £16 17s. 6d. per ton f.o.b. Hull, £17 f.o.b. Liverpool, and £17 2s. 6d. f.o.b. Leith. The forward position seems to have been neglected, and no business has transpired.

Nitrate of Soda.

The market for this article has advanced further, and the spot prices are now 18s. 3d. per cwt. for ordinary, and 19s. 3d. per cwt. for refined quality.

Sulphate of Ammonia.

From another source it is reported that the prices of this article are as follows: Outside London makes, £15 17s. 6d.; Hull, £16 12s. 6d.; Liverpool, £16 15s.; Leith, £16 17s. 6d.; Middlesbrough, £16 15s.

COAL TRADE REPORT.

Northern Coal Trade.

There had been a large production of coal until the holidays interfered; but for this week, there is the reduced output that is usual at this time, though, on the other hand, the idle days allow the collier fleet to arrive freely. Under such conditions, business is irregular—the quantity of coal at disposal for early sale being slight. Production in a day or two should be at its normal rate, but prices will be uncertain for two or three days yet. As far as the steam coal trade is concerned, the nominal quotations for the best Northumbrian steams are about 41s. to 45s.; second-class steams are 31s. to 37s.; and steam smalls from 21s. to 23s. per ton—all f.o.b. Forward prices are irregular—a heavy business being anticipated for next month. In the gas coal trade, there is a strong demand on contract account and to make up stocks, but supplies will only slowly overtake this demand. For best Durham gas coals, 30s. per ton f.o.b. is the nominal quotation; for second-class gas coals 27s. is asked; and for "Wear Specials" 31s. per ton f.o.b. But there is little business doing at these prices, owing to the scarcity of coal free for early sale. Of course, the contracts for coal for home use are under the Price of Coal (Limitation) Act, at figures much below those for export, where the prices are not so regulated. In a week or so, the more normal conditions of working will enable a better judgment to be formed as to the prices that are likely to prevail during the shipping season. Coal exports have further fallen this year in volume, and this should enlarge the demand. In the coke trade, the exports are heavier than a year ago, and prices are firm. Good gas coke is not now so full in production, and may be quoted from 26s. to 29s. per ton f.o.b. Freights on coal and coke have been easier, owing to the reduced output; but they are still heavy—57s. 6d. having been paid for the freight on coke to Dunkirk.

Irish Water-Works Contractor's Claims.

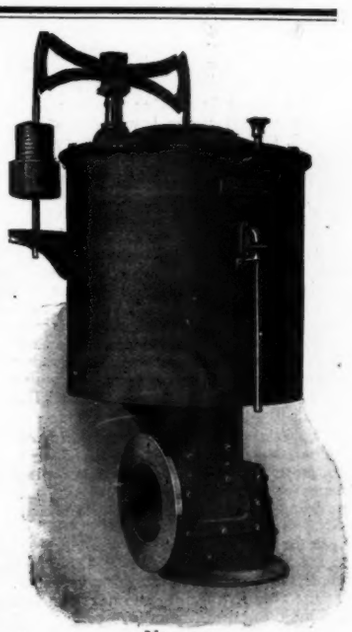
In the High Court of Ireland, before Mr. Justice Pim and a Special Jury, an action was heard in which John Callan, contractor, claimed £422 16s. 3d. from the Castleblaney (co. Monaghan) District Council; being part of a balance of a contract for the construction of water and sewerage works at Castleblaney, and in part for extra work and labour done, while plaintiff alternatively claimed £422 16s. 3d. as damages against Mr. Francis Bergin, the Council's Engineer, for wrongfully withholding his final certificate for the completion of the works, and against the Council for wrongfully and collusively by their agents influencing Mr. Bergin to withhold the certificate and the balance. Defendants denied collusion, and stated that Mr. Bergin withheld his certificate in the honest and independent belief that the plaintiff did not complete the work or extras, and did not carry out any of the things necessary to entitle him to a final certificate. The Council counterclaimed for £1707 2s. 9d., penalties for delay; £353 4s. 2d. for completing, maintaining, and upholding the works; and £25 damages for injury to buildings alleged to have been caused by plaintiff's negligence. In the alternative, defendants claimed £500 damages for delay and loss of the use of the water and sewerage works. Holding that there was no evidence of collusion between the defendants, his Lordship directed a verdict, and entered judgment, for them; the counterclaim to stand adjourned pending any proceedings for a new trial.

Tipton Gas-Works and the Rates.—At a meeting of the Tipton District Council last Tuesday, Mr. Powell said he was surprised and disappointed that the gas undertaking was not making any contribution this year towards the relief of the rates. The sum handed over was usually about £600; and he thought this year they would contribute at the very least £1000. The Chairman of the Gas Committee (Mr. W. W. Doughty) explained that the works had cost £123,835, and the amount owing at present in respect of them was £53,000. They had been extended during the past year, at a cost of over £2000; and this amount had been paid out of revenue. The extra cost of coal, too, as a result of the war, was between £3000 and £4000. Despite all this, the undertaking had had a good year; the record, in view of all the circumstances, being better than at any previous time.

BRADDOCK'S
RETORT-HOUSE
GOVERNORS
HAVE PROVED TO BE
SECOND TO NONE.

Many repeat orders have been received.

Braddock's New Patent Retort-House Governor is a further improvement and is especially desirable for use with Vertical Retorts.



No. 310.
Braddock's New Patent Enclosed Retort-House Governor.
Latest Type.

Further Particulars upon Application.

J. & J. BRADDOCK (BRANCH OF METERS LIMITED), Globe Meter Works, OLDHAM.
Telegrams: "BRADDOCK, OLDHAM." National Telephone No. 815.
AND 45 & 47, WESTMINSTER BRIDGE ROAD, LONDON, S.E.
Telegrams: "METRIQUE, LAMB LONDON." Telephone No. 2412 HOP.

War Time Wages at Barry.

Board of Trade arbitration proceedings have taken place at Barry relative to an application by the Council employees for increased wages. Mr. Llewellyn (who stated the case for the men) said that in February, 1915, the Council decided to grant a war bonus of 3s. to those of their employees earning under and up to 30s. per week, and 2s. for those over 30s. and up to 40s. per week. The men considered the standard rate in the district was of such a character as to warrant a general levelling-up. Referring to the gas stokers, he remarked that there was a rate of 5s. 4d. paid to ordinary stokers for an eight-hour shift. Time-and-a-half was granted for Sundays, and double time for holidays. The present application was for 5s. 6d. per shift for ordinary stokers, and 6s. per shift for leading stokers. The men also required the usual time-and-a-half for Sundays, double time for bank holidays, and a week's holiday in the summer. The increase, should it be granted, was required to be permanent. For the gas-fitters, he asked an increase of 1d. per hour, from 8⅜d. to 9½d., on the ground that the standard rate for plumbers in the district was 10½d. per hour. The Clerk of the Council (Mr. T. B. Tordoff) pointed out that in 1911 the Municipal Employees' Association agreed to a minimum wage of 30s. per week. At that time the roadmen, who represented the great bulk of the employees, were receiving 27s. 6d. per week, and the lamplighters 28s. 6d. In response to an application, the Council made an all-round rate of 29s. 6d., with 6d. in addition per week in respect of uniform. In February, 1915, the Council granted a war bonus on the total earnings; but the men asked that it should be paid on the ordinary weekly wage, apart from overtime. The Council acceded to this. The bonus involved an expenditure of £1391, representing a general district rate of nearly 2d. in the pound. Then came the present application. There were many men in the Council's employ who could not do a proper day's work, owing to advanced age; and he contended that they were not entitled to the advance. The award will be given in due course.

Roscommon Gas Company.—This Company, after payment of the usual dividend and voting bonuses of £15 and £5 to the Manager (Mr. T. M. Walsh) and Secretary (Mr. W. Black) respectively, carry forward to the credit of the profit and loss account £335. Mr. Walsh is said to hold the unique position in Ireland of being the only gas manager who is a town commissioner.

British Coalite Company's Barking Land.—The announcement is made by the Directors of the British Coalite Company that the sale of the Company's land at Barking has now been completed, and that out of the price received the first mortgage debentures are now being paid off. Subject to the payment of certain trifling charges, the second mortgage debenture stock will automatically become a first charge on the Company's assets.

Lighting in South Wales.—A Home Office lighting restrictions order for Monmouthshire, Cardiff, Barry, and Penarth has come into operation, and in Cardiff, it is reported, the gas and electric street-lamps now in lighting (at converging points, &c.) number a hundred. Estimates are to the effect that the order will cost the Corporation Electricity Department £20,000 in revenue, owing to the reduced amount of lighting that will be permissible.

Haywards Heath Gas Company.—Before turning to the business at the annual general meeting of this Company, the Chairman (Mr. C. Charleton) referred to the great loss the Board and the Company had sustained by the death of Mr. A. H. Cæsar, who had for a period of forty years rendered valuable services to the undertaking. The payment was agreed to of a dividend at the rate of 3⅛ per cent. for the six months to December, making 6¼ per cent. for the year.

Price of Gas at North Ormesby.—At a meeting of the Middlesbrough Corporation Gas and Electricity Committee last Tuesday, the question arose as to whether the price of gas at North Ormesby (which district was taken into the borough two years ago) should be the same as in the town proper, now that the new district no longer enjoys preferential rating. It was decided to reduce the price from the 1st inst. for ordinary meter consumers, and as soon as re-adjustments could be made for slot-meter users. It was reported that the gross profit for the year ended March 31 was £24,000, which would be sufficient to meet interest and redemption charges, and leave something over for capital expenditure.

Lurgan Gas Price.—At a meeting of the Lurgan Town Council, it was decided to increase the price of gas from 4s. 2d. to 4s. 6d. per 1000 cubic feet, subject to the customary allowances on that used for power purposes; and it was also resolved to change the slot-meters to the requirements of the increase. Mr. H. G. MacGeagh (the Chairman) said, in reference to comments as to the increase coming just after the purchase of the gas-works, that when Parliament fixed the maximum at 4s. 6d. during the passing of the Purchase Bill, no one anticipated the condition of affairs which now existed. Another consideration was that the Council had for the next five years to pay off £350 of sinking fund which had not been foreseen.

Wilton Gas-Works Management.—A recently-formed Association of Wilton Ratepayers, at their first quarterly meeting, discussed the finances of the borough, more particularly in reference to the gas-works. A resolution was moved—"That the meeting expresses its dissatisfaction at the management of the gas-works, and especially at the Council's method of producing its balance-sheet." No one, however, seconded it, so it fell through. A second resolution—"That this meeting expresses its anxiety at the accumulating deficit in the accounts connected with the gas-works"—met with a precisely similar fate to the first. One member said that they were all dissatisfied about the gas; but a meeting ought to have been held six months ago, if such a resolution as the first one was going to be passed. Now the Council were trying to put the matter right, it seemed a little out of order to say the ratepayers were dissatisfied. With regard to the accounts, he thought they were in a bigger fog than ever. Ultimately, the debate was adjourned to the next meeting, to be held three months hence. A Committee was appointed to go in the meantime into the whole financial question connected with the gas-works, and to report to the next meeting.

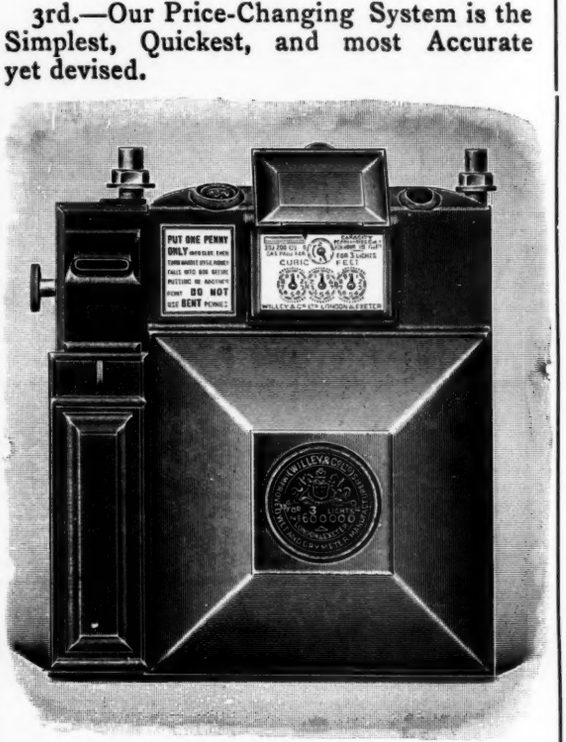
THREE POINTS

of advantage from the many found in our Slot Meters are:

1st.—They are Fraud Proof, and cannot be tampered with through the Slot.

2nd.—The Slot is closed when the maximum number of Coins have been inserted.

3rd.—Our Price-Changing System is the Simplest, Quickest, and most Accurate yet devised.



ALL PARTS INTERCHANGEABLE.

Tens of Thousands in use, and adopted exclusively by many Gas Companies.

WILLEY & CO., LTD.,
Exeter, London, Manchester, Leicester.

Telegrams:
"WILLEY, EXETER."
"GASVILLADO, KINLAND, LONDON."
"METERS, LEICESTER."
"WILMETER, MANCHESTER."

Telephone Nos.:
132 EXETER.
224 DALSTON, LONDON.
4777 LEICESTER.
7419 CITY (MANCHESTER).

LONDON WORKS & OFFICES:
91-95, Hertford Road, Kingsland, N.
LEICESTER:
5, Oxendon Street.
MANCHESTER:
50, John Street, Chorlton-on-Medlock.
AGENTS FOR SCOTLAND:
D. M. NELSON & CO., 53, WATERLOO STREET, GLASGOW.

City of Santos Improvements Company.—The annual meeting of the Company was presided over by Mr. D. M. Fox, who said a reduction in revenue had been experienced, due entirely to the fall in the value of the milreis. Had the receipts in currency for 1915 been convertible into sterling at the rate ruling in 1914, the result, after making the same deductions for depreciation, &c., would have been sufficient to permit of the payment of a dividend of 5 per cent. on the ordinary capital, instead of the reduced dividend of 3 per cent. recommended. As to the various undertakings, the quantity of gas delivered for consumption (87,741,000 cubic feet) showed a decrease of 10·4 per cent. Private lighting had fallen off by 15 per cent.; but the demand for gas for cooking had been well maintained, and the number of stoves installed exhibited a satisfactory increase. The tonnage of coal carbonized showed a reduction of 13½ per cent. The water supply to private consumers had been about 6 per cent. less, while that for shipping had also still further decreased. The consumption of energy for electric light and power showed a steady increase. The report was adopted, and a hearty vote of thanks was passed to Mr. Bernard Browne (the Manager) and the staff "in recognition of their faithful services to the Company under specially trying conditions."

The Darlington Gas Committee had before them last Wednesday the question of the utilization of bye-products at the gas-works. The opinion was expressed that it would be to the advantage of the Corporation to erect machinery for the conversion of the coke breeze and pitch into briquettes; and it was resolved that a deputation should visit works where briquette-making is carried on. The pitch was exported to Belgium before the war.

At a meeting in connection with the Stockton-on-Tees Gas-Works Social Club last Tuesday, Mr. Matt Dunn (the Gas Manager), who is Chairman of the Organizing Committee, presented a statement which showed that a balance of £140 remained to be handed over to the St. Dunstan's Hostel for blind soldiers and sailors, after the payment of all accounts in respect of a recent matinee promoted by the club. The Mayor (Mr. Bertrand Watson) said the result had exceeded his highest expectations; and it had only been rendered possible by the vigorous and enthusiastic way in which the effort had been taken up. He presented Mr. Stainton (who gave the free use of the Hippodrome, &c.) with a framed illuminated acknowledgment of his services, and handed, for the purpose of the function, to Mr. Dunn a case of pipes, in recognition of what he had done.

STOCK MARKET REPORT.

Business on the Stock Exchange last week was necessarily handicapped by the fact of its curtailment to a period of four days' activity followed by a four days' closure. But in spite of this, there was a very fair amount doing, and the general tone was remarkably cheerful, considering the acute Government crisis which dominated everything almost up to the close. Home Government issues opened very firm, and maintained their position till Wednesday, when they gave way to the public anxiety, only to recover again on Thursday, when the Cabinet settlement was announced. The War loan finished up at advanced figures. Home Rails were almost stagnant, and yielded no particular indications. In the Foreign market, the French loan was quite firm, supported by the military operations at Verdun and the improvement in the Exchange. But Japanese made no recovery. Americans started fairly well, but gave way later under the depressing influence of the Mexican position and the ultimatum to Germany. Argentines improved, in response to a considerable move to buy. South African showed no stability; the tendency varying from day to day with much uncertainty. As is usual now, some of the strongest points were to be found in the Miscellaneous group. Rubbers, oils, and teas showed abiding firmness; and shipping concerns were in good demand. In the Money Market, there was an abundant supply to provide short-loan demands; but discount rates were firm. In matters of general interest, Exchequer Bonds appear to be going off nicely; but in order to stimulate an increased demand, the Treasury are offering the Banks favourable terms of conversion of War Loan into Exchequer Bonds on a scale proportionate to the amounts they may apply for on behalf of their customers. Business in the Gas Market was well up to the average measure of a four days' week, and was fairly well distributed through the list of securities. Gas Light Ordinary maintained its firm position, and the general tone of the whole market was quite satisfactory.

Bargains done for cash during the week were as follows: On Monday, Buenos Ayres 62½, Commercial 4 per cent. 73, 74, Gas Light ordinary 75⅞, 76, 76⅛, 76¼, 76⅜, 76½, Imperial Continental 59¼, 59⅜, Primitiva 1⅞⅜, ditto preference 71s., 71s. 3d., South Metropolitan 76⅜. On Tuesday, Gas Light ordinary 75¼, 76, 76⅛, 76½, ditto debenture 59⅜, Imperial Continental 59, 59⅝, 59½, 60, Primitiva preference 71s. 3d., South Metropolitan 76½. On Wednesday, Continental Union preference 54½, Gas Light ordinary 75⅝, 75⅞, Imperial Continental 58, 59½, 59¼, 59½, 59⅜, Oriental 100, Primitiva 1⅛, 1⅞, ditto preference 72s., Tuscan 1½. On Thursday, Gas Light ordinary 75¼, 76, Monte Video 8⅜, 8¼, South Metropolitan 76, 76¼, 76⅜, South Suburban 81. On Friday and Saturday the Exchange was closed.

The Bank rate is 5 per cent.—as fixed on Aug. 8, 1914.

At an inquest on the body of a Handsworth nursemaid, when a verdict of "Accidental death" was returned, it was stated that deceased was bathing a child when her clothes became ignited by coming in contact with a gas-stove. An attempt was at once made to extinguish the flames, but the girl ran along the landing and down the stairs. Death was due to septicæmia.

ANTE-WAR PRICES AND DIVIDENDS, LATEST DIVIDENDS, AND LAST WEEK'S BARGAINS.

Issue.	Share.	When ex-Dividend.	Previous Div or Dividend & Bonus.	Last Dividend.	NAME.	Closing Prices, July 30, 1914.	Yield on Highest Closing Price.	Lowest and Highest Prices of Bargains.
£			p.c.				£ s. d.	
1,551,868	Stk.	April 8	2½	5½	Alliance & Dublin Ord.	59—64	8 18 2	..
374,000	,,	July 10	4	4	Do. 4 p.c. Deb.	76—79	5 1 3	..
280,000	5	April 29	7½	3/-	Bombay, Ltd.	5⅞—6⅜	5 17 8	..
50,000	10	Feb. 26	16	15/-	Bournemouth Gas and Water — 10 p.c.	29—30	5 6 8	..
333,110	10	,,	7	7/-	Bournemouth Gas and Water — B 7 p.c.	15—15½	4 10 4	..
115,000	10	,,	6	6/-	Bournemouth Gas and Water — Pref. 6 p.c.	13½—14	4 5 9	..
159,740	—	—	—	4	Bournemouth Gas and Water — 4 p.c. Deb.	..	—	..
992,045	Stk.	Feb. 26	†14	£6/-	Brentford A Consold.	261—266	5 5 3	..
734,940	,,	,,	†11	55/-	Do. B New	204—209	5 5 3	..
55,000	,,	,,	5	5	Do. 5 p.c. Pref.	109—111	4 10 1	..
221,400	,,	June 11	4	4	Do. 4 p.c. Deb.	91—93	4 6 0	..
217,380	Stk.	Feb. 26	11	10½	Brighton & Hove Orig.	208—213	5 8 4	..
244,200	,,	,,	8	7½	Do. A Ord. Stk.	154—159	5 0 8	..
530,000	20	Mar. 26	19½	22/6	British	44—45	5 11 1	..
120,000	Stk.	June 26	4	4	Do. 4 p.c. Deb. Stk.	88—90	4 8 11	..
245,771	Stk.	June 26	4	4	Buenos Ayres 4 p.c. Deb.	85—87	4 12 0	62½
100,000	10	—	—	—	Cape Town & Dis., Ltd.	1½—2½	—	..
100,000	10	—	—	4/6	Do. 4½ p.c. Pref.	4—6	—	..
100,000	Stk.	June 26	4½	4½	Do. 4½ p.c. Deb. Stk.	70—75	6 0 0	..
157,150	Stk.	Feb. 26	5	5	Chester 5 p.c. Ord.	108—110	4 10 11	..
1,513,280	Stk.	Feb. 12	5/9/4	49/4	Commercial 4 p.c. Stk.	106—108	5 1 2	73—74
560,000	,,	,,	5½	46/8	Do. 3½ p.c. do.	103—105	5 1 6	..
475,000	,,	June 11	8	3	Do. 3 p.c. Deb. Stk.	69½—71½	4 3 11	..
800 000	Stk.	,,	4	4	Continental Union, Ltd.	76—79	5 1 3	..
200 000	,,	,,	7	7	Do. 7 p.c. Pref.	115—118	5 18 8	54½
278,400	—	—	—	11½	Croydon B and C 7 p.c.	..	—	..
492,270	Stk.	—	6	5⅞	Derby Con. Stk.	123—125	4 16 0	..
55,000	,,	—	4	4	Do. Deb. Stk.	102—104	3 16 11	..
1,002,180	10	July 29	10	10/-	European, Ltd.	17½—18	5 11 1	..
16,397,185	Stk.	Feb. 10	4/17/4	42/-	Gas Light and Coke — 4 p.c. Ord.	98—102	4 15 6	75⅝—76½
2,600,000	,,	,,	3½	3½	Gas Light and Coke — 3½ p.c. max.	76—79	4 8 7	..
4,062,235	,,	,,	4	4	Gas Light and Coke — 4 p.c. Con. Pref.	96—99	4 0 10	..
4,674,850	,,	June 11	3	3	Gas Light and Coke — 3 p.c. Con. Deb.	72½—74½	4 0 6	59⅝
130,000	,,	,,	10	10	Gas Light and Coke — 10 p.c. Bonds	..	—	..
258,740	Stk.	Mar. 12	5	4½	Hastings & St. L. 3½ p.c.	87—89	5 12 4	..
70,000	10	April 29	11	6	Hongkong & China, Ltd.	16½—16¾	6 11 4	..
86,600	—	—	—	9½	Hornsey 7 p.c.	..	—	..
131,000	Stk.	Mar. 12	7⅞	7½	Ilford A and C	151—154	5 2 4	..
65,780	,,	,,	6⅜	5⅞	Do. B	115—118	5 8 0	..
65,500	,,	June 26	4	4	Do. 4 p.c. Deb.	92—94	4 5 1	..
4,940,000	Stk.	May 14	9	4½	Imperial Continental	150—160	5 12 6	58—60
1,235,000	Stk.	Feb. 12	3½	3½	Do. 3½ p.c. Deb. Red.	84—86	4 1 5	..
235,242	Stk.	Mar. 12	6½	6½	Lea Bridge Ord. 5 p.c.	119—121	5 7 6	..
2,498,905	Stk.	Feb. 26	10	5	Liverpool 5 p.c. Ord. — A	211—213	4 13 11	..
					Liverpool 5 p.c. Ord. — B	146—148	4 14 7	..
306,083	,,	June 26	4	4	Do. 4 p.c. Pr. Deb. Stk.	..	—	..
75,000	5	June 11	6	2/-	Malta & Mediterranean	4½—4⅝	6 9 9	..
250,000	100	April 1	4½	4½	Met. of Melbourne 4½ p.c. Deb.	99—101	4 9 1	..
541,920	20	May 28	4	6/-	Monte Video, Ltd.	11½—12	6 13 4	8⅜—8¾
1,875,892	Stk.	July 29	4½	4½	Newc'tle&G'tesh'd Con.	98½—99½	4 10 6	..
529,705	Stk.	June 26	3½	3½	Do. 3½ p.c. Deb.	82—83	4 4 10	..
55,940	10	Feb. 26	7/14/0	7/8⅝	North Middlesex 7 p.c.	14—15	5 2 8	..
300,000	Stk.	May 14	8	8	Oriental, Ltd.	117—122	6 11 2	100
60,000	5	Mar. 26	10	1/-	Ottoman, Ltd.	7½—7⅞	6 9 0	..
60,000	50	Feb. 26	18	65/-	Portsea, Island B	128—131	4 19 3	..
100,000	50	,,	12	60/-	Do. C	118—121	4 19 2	..
52,000	50	,,	10	—	Do. D	..	—	..
249,980	5	April 29	8	—	Primitiva Ord.	5½—6	6 13 4	1⅞⅞—1⅞⅞
499,960	5	June 26	5	2/6	,, 5 p.c. Pref.	4⅞—5	5 0 0	71/—72/-
521,600	100	June 2	4	4	,, 4 p.c. Deb.	91—93	4 6 0	..
—	—	—	—	4	,, ,, ,, 1911	..	—	..
346,198	Stk.	June 26	4	4	River Plate 4 p.c. Deb.	85—87	4 12 0	..
150,000	10	May 14	6	6/-	San Paulo — 6 p.c. Pref.	10½—11	5 9 1	..
125,000	50	July 1	5	5	San Paulo — 5 p.c. Deb.	47—49	5 2 0	..
135,000	Stk.	Mar. 12	10	10	Sheffield A	223—224	4 9 3	..
209,984	,,	,,	10	10	Do. B	222—224	4 9 3	..
523,500	,,	,,	10	10	Do. C	220—222	4 10 1	..
90,000	10	May 28	9	6/-	South African	10½—11½	7 16 6	..
6,609,895	Stk.	Feb. 10	5/4/0	44/-	South Met., 4 p.c. Ord.	111—113	4 16 8	76—76¼
1,895,445	,,	July 10	3	3	Do. 3 p.c. Deb.	73½—74½	4 0 6	..
224,830	Stk.	Feb. 26	8½	8	South Shields Con. Stk.	157—159	5 6 11	..
952,795	Stk.	Feb. 26	6	48/4	S'th Suburb'n Ord. 5 p.c.	114—116	5 3 5	81
60,000	,,	,,	5	5	Do. 5 p.c. Pref.	110—112	4 9 3	..
135,000	—	—	—	48/4	Do. West Kent.	..	—	..
187,558	,,	June 26	5	5	Do. 5 p.c. Deb. Stk.	116—118	4 4 9	..
629,740	Stk.	May 14	5	5	Southampton Ord.	99—102	4 18 0	..
120,000	Stk.	Feb. 12	7½	7½	Tottenham District — A 5 p.c.	135—138	5 8 8	..
782,275	,,	,,	6	6	Tottenham District — B 3½ p.c.	115—117	5 2 7	..
181,255	,,	June 26	4	4	Tottenham District — 4 p.c. Deb.	87—89	4 9 11	..
182,380	10	Dec. 30	5	—	Tuscan, Ltd.	5—6	8 6 8	1½
149,900	10	July 1	5	5	Do. 5 p.c. Deb. Red.	93—95	5 5 3	..
236,478	Stk.	Mar. 12	5	5	Tynemouth, 5 p.c. max.	103½—109½	4 11 4	..
					Wandsworth, Wimbledon, and Epsom—			
80,000	Stk.	Feb. 26	8⅜	78/9	Wandsworth A 5 p.c.	151—156	5 7 4	..
255,636	,,	,,	6⅞	63/9	,, B 3½ p.c.	129—134	5 2 7	..
108,075	,,	,,	5/17/8	55/1½	,, C 3½ p.c.	110—115	5 2 0	..
352,000	,,	,,	6½	57/6	Wimbledon 5 p.c.	117—122	5 0 5	..
98,000	,,	,,	6⅜	63/9	Epsom 5 p.c.	121—126	5 5 3	..
88,416	,,	June 26	3	3	3 p.c. Deb. Stk.	66—69	4 6 11	..

† Paid on Old 10 p.c. and 7 p.c. Standard Stocks.

APPLICATIONS FOR PATENTS.

[Extracted from the "Official Journal" for April 19.]

Nos. 5198—5579.

Bellerby, J.—"Fractional distillation of volatile liquids." No. 5306.
Benton, W. A.—"Manufacture of tar oils." No. 5358.
Brayshaw, E. R. & S. N.—"Furnaces." No. 5333.
Christopher, J. E.—"Recuperative systems." No. 5544.
Cockey, F. G.—"Coin-freed meters." No. 5399.
Dobbins, E. J.—"Tops for gas cooking or heating plates." No. 5298.
Durand, E. L.—"Illumination." No. 5385.
France, A. G.—"Reflectors and shades." No. 5573.
Gas-Meter Company.—See Cockey. No. 5399.
Meadows, J. M.—"Gas alarm and telegraph." No. 5280.
Sadler and Co.—See Bellerby. No. 5306.
Searle, W. S.—See Durand. No. 5385.
Seddon, W. H.—"Compressors." Nos. 5347-8.
Sharpe, W. C.—"Petrol air gas." No. 5516.
Somerville, J. M.—"Igniting gas-burners." No. 5462.
South Metropolitan Gas Company.—See Somerville. No. 5462.
Turner, E.—"Gas-regulators." No. 5537.
Watts, J. E.—"Incandescent burners." No. 5481.
Yates, H. J.—See Brayshaw. No. 5333.

NEWSPAPERS FOR NEUTRAL COUNTRIES.

The Secretary of the War Office has issued the following order:

> The public are informed that newspapers and other printed publications will not be sent to Neutral European Countries unless posted direct from the office of publishers or newsagents who have obtained permission from the War Office for this purpose. Persons desiring to send newspapers, &c., to Neutral European Countries should, therefore, give their orders for execution to publishers or newsagents who have obtained such permission.

The Publisher of the "Journal" has obtained the required permission of the War Office; and he will, on receipt of instructions, forward copies direct from the office to any neutral country.

Tavistock Lighting Company.—The annual meeting of the Tavistock Lighting Company was held last Wednesday, when the accounts presented showed the profit on the revenue account for the year was £969; and after payment of an interim dividend, absorbing £480, the Directors recommended a final dividend of 3s. 4d. per share on the original capital and 2s. 4d. per share on the additional capital, which was agreed to.

Oldham Water-Works Labourers and their Wages.—Recently the labourers employed at the Oldham Water-Works asked to be paid at the same rate as navvies. At a subsequent meeting of the Committee, the General Manager (Mr. Arthur Andrew) reported that he had been in communication with Mr. J. R. Clynes, M.P. (the Secretary of the local branch of the Gas-Workers' Union), and that as a result the men had agreed to modify their claim. They now asked to be paid ½d. per hour less than the rate prevailing at any time for navvies. He added that the men were not looked upon as navvies by the Corporations of Manchester, Rochdale, Stockport, and other towns; and the Oldham scale of pay at present was higher than that of these places.

The Wakefield Gas Company applied for exemption for a batch of employees, from the Secretary to stokers and carters. The men appealed for were skilled workers in their own particular departments, who had been with the Company for years, and were absolutely indispensable. The Company claimed that certain outdoor men were just as essential to the business as indoor men; but under pressure from the Advisory Committee, the claims in respect of two men had been withdrawn, and altogether three carters had joined the forces. It was mentioned that one of the stokers who had attested and received his 2s. 9d. was 48 years of age. Conditional exemption was granted in all these cases.

Lecturing to the members of the Bradford and District Workers' Educational Association, Mr. E. J. Sutcliffe foreshadowed as a probability the manufacture of gas of lower candle power than at present obtains. Referring to the local gas supply, he stated that Bradford was not far behind London in providing what was then the new illuminant; the old Bradford Gas Company having started operations in 1821, with capital amounting to £15,000. Meters were introduced in 1827. To-day the Bradford gas-works carbonized about 1000 tons of coal per 24 hours, and produced 11,865,000 cubic feet of gas. The area of supply measured 28,000 acres. Bradford was the first place to adopt a complete system of incandescent lighting throughout the streets.

The minutes of the Gas Committee which were adopted at the monthly meeting of the Huddersfield County Borough Council stated that the period for which the appointments of the Engineer and Manager, Commercial Manager, and Distribution Superintendent were made had now expired; and it had been resolved that Mr. H. Singleton be appointed Gas Engineer and Manager, subject to his entering into an agreement to be prepared by the Town Clerk. The minutes also included a recommendation to increase Mr. Singleton's salary from £250 to £450 per annum, rising by five annual increments of £30 to £600 per annum. Mr. Mitchell pointed out that twelve months ago Mr. Singleton was appointed Manager provisionally; and he had proved quite capable, and had performed his duties to the entire satisfaction of the Committee.

WANTED, FOR SALE, CONTRACTS, &c., ADVERTISEMENTS IN THIS WEEK'S "JOURNAL."

Appointments, &c., Vacant.

Pupil Apprentice. No. 6172.
Manager (Coke Ovens). Yorkshire Coking and Chemical Company, Pall Mall, S.W.
Manager. Brampton Gas-Works.
Traveller. No. 6174.
Retort House Foreman. No. 6170.
Erector and Repairer, &c. Desborough Gas-Works.

Appointments, &c., Vacant (*continued*).

Stoker. Llangollen Gas Company.
Stokers. Nixon's Navigation Company, Mountain Ash.

TENDERS FOR

Coal.

Bath Gas Company. Tenders by May 3.
Sevenoaks Gas Company. Tenders by May 1.

Tenders for Coal (*continued*).

Sheffield Gas Company. Tenders by May 4.
Ulverston Gas and Water Committee. Tenders by April 27.

Oxide (Spent).

Keighley Gas Committee. Tenders by May 10.

Vitriol.

Keighley Gas Committee. Tenders by May 10.

NOTICES TO CORRESPONDENTS, ADVERTISERS, AND SUBSCRIBERS.

No notice can be taken of anonymous communications. Whatever is intended for insertion in the "JOURNAL" must be authenticated by the name and address of the writer—not necessarily for publication, but as a proof of good faith.

COPY FOR ADVERTISEMENTS for the "JOURNAL" should be received at the Office NOT LATER than TWELVE O'CLOCK NOON ON MONDAY, to ensure insertion in the following day's issue.

Orders to Alter or stop PERMANENT ADVERTISEMENTS should be received by the FIRST POST on Saturday.

Wanted, For Sale, and Tender Advertisements, Six Lines and under 3s.; each additional Line, 6d.

TERMS OF SUBSCRIPTION to the "JOURNAL."

United Kingdom: One Year, 23s. 6d.; Half Year, 12s.; Quarter, 6s. 6d.
Payable in advance. If credit is taken, an extra charge of 4s. a year is made.

Abroad (in the Postal Union): £1 7s. 6d., payable in advance.

All Communications, Remittances, &c., to be addressed to Walter King, 11, Bolt Court, Fleet Street, London, E.C.

Telegrams: "GASKING, FLEET LONDON." Telephone: Holborn 6857.

OXIDE OF IRON.

O'NEILL'S OXIDE
For GAS PURIFICATION.
LARGEST SALE OF ANY OXIDE.

SPENT OXIDE PURCHASED IN ANY DISTRICT.

GAS PURIFICATION & CHEMICAL CO., LD.,
Palmerston House,
Old Broad Street, London, E.C.

"VOLCANIC" FIRE CEMENT.
Resists 4500° Fahr. Best for GAS-WORKS.
Andrew Stephenson, 171, Palmerston House, Old Broad Street, London, E.C. "Volcanism, London."

J. & J. BRADDOCK (Branch of Meters Limited), Globe Meter Works, Oldham, and 45 & 47, Westminster Bridge Road, London, S.E.
WET AND DRY GAS-METERS, PREPAYMENT METERS, STATION METERS AND GOVERNORS.
Repairs receive prompt attention.
Telephones: 815 Oldham, and 2412 Hop, London.
Telegrams—
"Braddock, Oldham," and "Metrique, Lamb London."

SEND your inquiries for Carburetted HYDROGEN AND BLUE WATER-GAS PLANT, also TAR DEHYDRATING PLANT and other GAS-WORKS APPARATUS to—

BALE AND HARDY,
39, Victoria Street, Westminster, S.W.

OXIDE OF IRON.
We are in a position to Supply Oxide of Iron promptly, and invite Enquiries.
SPENT OXIDE WANTED.

BALE & CHURCH, LTD.
5, Crooked Lane, London, E.C.

"TORTO" FIRE CEMENT.

BALE & CHURCH, LTD.
5, Crooked Lane, London, E.C.

KLEENOFF," THE COOKER CLEANSER.
Tins for sale to Consumers.
In Bulk for Works Use.

BALE & CHURCH, LTD.
5, Crooked Lane, London, E.C.

MITCHELL'S PATENT SLOT METER PAD & OTHER LOOKS. KENTISH TOWN, N.W. **J. & J. BRADDOCK, LTD.**